The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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Contents

PAGE

EDITORIAL: "1924"; Crystal Sulphate of Ammonia; Saturator Conditions and Crystal Size; The Merchants' Place in Business; Room for New Ideas 639
1924.—A Retrospect 644
The Nitrogen Industry. By Dr. E. B. Maxted 647
Developments in Heavy Chemicals in 1924. By P. Parrish .. 649
Progress in the Lime Industry 651
The Fine Chemical Industry. By A. S. Wilson-Jones 652
Chemical Inventions 653
The Dyestuffs Industry. By L. B. Holliday 655
Chemical Engineering 656
Reports of Chemical and Allied Societies 658
References to Current Literature 666
Patent Literature 667
Commercial Intelligence and Company News 670

NOTICES:—All communications relating to editorial matter should be addressed to the Editor, who will be pleased to consider articles or contributions dealing with modern chemical developments or suggestions bearing upon the advancement of the chemical industry in this country. Communications relating to advertisements or general matters should be addressed to the Manager.

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1924

IF there has been no historical development in chemical industry during 1924 the year has witnessed, as our correspondents show in detail, many interesting advances and extensions. Trade has fluctuated, within margins, however, that have not gone very high or very low. The industry, taken as a whole, has managed to hold its own, and is in a condition to profit immediately from any favourable change in conditions. Beyond the gradual stabilisation of conditions in Europe, promising an increase of international exchange and therefore an increase of industrial activity, no striking changes seem imminent. The present Government has a majority large enough to enable it to run the full Parliamentary limit and to carry through almost any measures it desires, and any legislative measures respecting trade are more likely to extend the protective principle than to restrict it. The industry has had a great advertisement through the chemical exhibit organised at Wembley, and must ultimately benefit through the wider knowledge of the productive resources of British chemical manufacturers, chemical engineers, and dyestuff makers. Among the principal chemical organisations there has been a distinct tendency towards closer co-operation, though no definite steps have yet been taken towards actual amalgamation or, what seems more possible, general federation.

Coming to particular branches, the dyestuffs industry has again been the subject of some controversy. Considerable anxiety was caused by the proposals for an agreement between the British Dyestuffs Corporation and the Interessen Gemeinschaft, on account both of its possible effect on the independent dyestuff manufacturers and of its effect also on the research and development sides of the British industry. One of the closing acts of the last Government was to announce its decision to veto the proposed agreement. More recently changes have been announced in the directorate of the B.D.C. Of the industry generally, Major Holliday sums up 1924 as a good year so far as achievements are concerned but a bad year so far as profits are concerned. Certainly there has been considerable progress in many lines of colours. One of the most notable discoveries is one in connection with anthraquinone vat dyestuffs, of which we hope to give some account next week.

Mr. Parrish reviews in his thorough way the main problems in the heavy chemical industry, and Dr. Maxted the principal developments in the nitrogen industry, while in the fine chemical branch a number of small but not unimportant advances have to be recorded. The synthetic method of nitrogen fixation is now well established in this country on a commercial scale, thanks to the enterprise of Brunner, Mond and Co., and the number of patents taken out indicates the activity of research, a good deal of which is directed to catalysts. The arc and cyanamide methods seem to attract less attention. Side by side with chemical research, increased attention is being given to chemical engineering—a field in which the Chemical Engineering Group and the Institution of Chemical Engineers are doing excellent work.

Perhaps, among the various contributions which make up our present issue, there is none more important or suggestive than our Patents Correspondent's review of the chemical inventions of the year. These, it will be seen, cover a very wide field. Many will agree with our correspondent's remark that there are few processes or forms of apparatus now in use that could not be improved by the application to them of some of the published inventions, but that unfortunately too often inventors of the greatest merit pass into obscurity because of the inventor's failure to gain the manufacturer's interest. Another point worth noting is the large number of patents for new colours or new inter-

mediates mainly from German and Swiss sources, while British inventors are more concerned with the practical details of the manufacture of well known products or intermediates.

Lastly, a point of considerable interest and promise is the large output of text books dealing with chemical research and technology and the steady absorption of such literature by members of the profession. The eagerness of the younger members especially to keep themselves abreast of the best scientific thought and technical practice is as praiseworthy as the willingness of first class authorities to make such literature available. Believing that this kind of work is of the very highest value to the nation, we may take some pride in the remarkable series of text books on the main branches of the industry which have been issued by Ernest Benn, Ltd., within the last two or three years.

Crystal Sulphate of Ammonia

It is clear from the recent report of the B.S.A.F. that buyers have a preference for neutral sulphate of ammonia, which is composed of distinct crystals. Indeed, it is suggested that the crystals should be "as large as the plant can produce." It is perfectly sound to discountenance the production of sulphate of ammonia in a powdery form. Not only does the farmer lose an appreciable quantity in the drilling or sowing process, but the manufacturer suffers in many ways from salt of this character. A powdery salt is much more difficult to dry than a crystalline one, and when dry the tendency to caking is much more pronounced than with the other form. On the other hand, there must be a limit to the size of the crystal, and this certainly needs to be defined without reference to the plant. In point of fact, it is known that plants of the same design and characteristics in some cases produce sulphate of ammonia in a powdery form, while in others a distinct crystal is obtained. It is obvious that the suggestion that the crystal should be as large as the plant can produce is one which does not convey anything definite. It is appreciated that it is not an easy matter to define crystal size. This is largely due to irregularities of shape. Crystal size may be measured approximately by reference to screening characteristics, and experts suggest that the following would cover a good quality salt:—

Forty per cent. remaining on a 30 by 30 mesh screen.

Eighty per cent. remaining on a 50 by 50 mesh screen.

Not more than 10 per cent. should pass an 80 by 80 mesh screen.

Several articles have been contributed during the course of the year, all of which have hinted that information concerning the factors governing the production of sulphate of ammonia of a definite crystalline form would be welcomed.

Saturator Conditions and Crystal Size

It is known that the conditions obtaining within the saturator have an important bearing upon the size of the crystal ultimately produced. Some technicians imagine that an equally important factor is to cool slowly during the process of ejecting the salt from the saturator. It is true that with the crystallisation of copperas, Epsom salts, or sulphate of copper, etc., in an ordinary stationary crystallising vessel, slow cooling and the absence of disturbance or agitation will result in the formation of large crystals. But with the production of sulphate of ammonia having a distinct crystalline structure the proposition is a different one. Neither the saturator nor the centrifuge can be regarded as typical of a crystallising vessel.

The functions of the saturator are four-fold: (a) a distributor, (b) an absorber, (c) an evaporator, and (d) a storage vessel. It is conceivable that the distribution of the ammonia gas through the cracker pipes of the saturator may be such as to affect the formation of crystals of definite structure. Equally, the absorbing medium may not possess the requisite characteristics, that is, the percentage acidity may be too high or the temperature too low. Again, the extent to which evaporation takes place in the saturator, in that it affects the question of mother liquor, is a matter of some significance. The size of the well of the saturator, which serves as a storage chamber for the salt, may also play an important part. It is known that where the acid is fed intermittently to the saturator, the sulphate of ammonia produced is invariably very fine. It has been suggested that this is due to high initial acidity. So far as the centrifuge is concerned, this merely functions as a dryer, and it is feared that this piece of plant does not afford much opportunity for regulated cooling.

Whatever may be the governing factors—and it is believed that some of these have already been touched upon—it is certain that the question of the production of sulphate of ammonia having distinct crystals of reasonable uniformity is not a simple problem, but one where many variable conditions are met, and the extent to which either or any of these conditions affects the crystal structure can only be determined by intimate acquaintance with all the details of the process.

The Merchant's Place in Business

The evidence given by Mr. F. T. T. Reynolds last week before the Government Committee on Industry and Trade sets out very clearly and fairly the functions of the merchant in the promotion of trade. We see nothing in it that can be considered hostile to the manufacturing interest; on the contrary, where a good understanding exists as to the limits of the two spheres, the merchant may be a very valuable ally to the producer. Even the great concerns which are able to undertake their own merchanting generally recognise a few of the larger merchant houses as agents, and for the great majority of producers the merchant is indispensable for the marketing of their goods. His knowledge of foreign markets, his familiarity with the mysteries of shipment and distribution, and his network of trade connections built up by long experience are assets of real value to British industry. Mr. Reynolds's plea is that there should be an official recognition of

the merchant corresponding to the facts of his vocation, and it is not easy to see on what grounds so reasonable a claim can be resisted. Nor is it quite fair to regard all merchants—though some such there may be—as always the friend of the foreign producer and the enemy of the home producer. There is room for a friendlier understanding between the manufacturer and the genuine distributor.

Room for New Ideas

A SHORT account is given elsewhere of an annual conference scheme which Naylor Brothers, Ltd., have for some years carried out with excellent results all round. Once a year the directors, the outside representatives, the heads of departments and the technical and research staff spend a full week in conference, reviewing the problems of the year as they are seen by the different sections, considering new conditions and new opportunities for extension, and generally aiming at the more perfect co-ordination of the whole machinery of production and marketing. All this not only makes for a steady flow of new and refreshing ideas into the business, but equally develops a good personal understanding throughout the whole staff. The idea may be commended for imitation. The more sectional staffs know of one another the better they work together, and the more the responsible directors keep in direct touch with every aspect of the industry through their staffs the better for the business and for the spirit in which it is conducted. Very few concerns to-day can afford to live on the past; indifference to new ideas and neglect of progressive research almost seem to invite disaster. An annual conference seems to us an excellent tonic which might be more generally applied.

Points from Our News Pages

A Review of the activities of the Chemical Industry during the past 12 months is given on page 644.

Dr. E. B. Maxted reviews the progress of the Nitrogen industry in 1924 (p. 647).

A comprehensive survey of the developments in Heavy Chemicals is contributed by Mr. P. Parrish (p. 649).

The Year's Progress in the Lime Industry is recorded (p. 651).

The Fine Chemical Industry is reviewed by Mr. A. S. Wilson-Jones (p. 652).

Chemical Inventions of 1924 are noted on page 653.

Mr. L. B. Holliday deals with the Dyestuffs Industry (p. 655).

A review of the year's Chemical Engineering appears on p. 656.

Reports of the Chemical and Allied Societies will be found on p. 658, and it is interesting to note that in most cases progress is reported and memberships have been maintained.

A noteworthy example of the effective co-operation of employers and employees is reported on p. 664.

Books Received

MASS SPECTRA AND ISOTOPES. Twenty-sixth Robert Boyle Lecture by Dr. F. W. Aston. London: Humphrey Milford, Oxford University Press. Pp. 16. 1s.

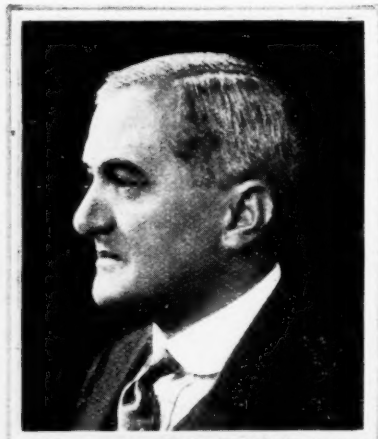
SYNTHETIC ORGANIC COMPOUNDS. By Dr. S. P. Schotz. London: Ernest Benn, Ltd. Pp. 412. 45s.

EXERCISES IN GENERAL CHEMISTRY. By Horace G. Deming. London: Chapman and Hall, Ltd. Pp. 248. 9s.

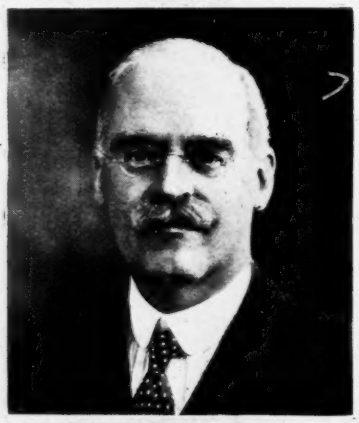
The Calendar

1925 Jan.		
5	Institution of the Rubber Industry (London Section): "Mechanical Structure of Rubber." A. Healey.	Engineers' Club, Coventry Street, London.
5	Society of Chemical Industry (London): "An Early Chapter in the Benzol Industry." Wilfred Irwin. 8 p.m.	Burlington House, Piccadilly, London.
6	West Yorkshire Metallurgical Society: "The Value of some Workshop and Laboratory Tests." 7.30 p.m.	George Hotel, Huddersfield.
6	Hull Chemical and Engineering Society: "Lubrication." T. A. Nightscales. 7.45 p.m.	Grey Street, Park Street, Hull.
6	Institute of Metals (Birmingham Section): "Cobalt: Its Production and Some of Its Uses." T. H. Gant. 7 p.m.	Chamber of Commerce, New Street, Birmingham.
6	Sir John Cass Metallurgical Society: "Works Costing." C. H. Richardson.	
9	Institute of Metals (Sheffield Section): "Die Casting." A. H. Mundey. 7.30 p.m.	The University, St. George's Square, Sheffield.
9	Society of Chemical Industry (Manchester Section): "The Melting Point of Coal Ash." Part II.	16, St. Mary's Parsonage, Manchester.
9	West Cumberland Society of Chemists and Engineers: "The Structure of Matter." E. H. Todd. 7 p.m.	Workington.
10	Institute of Metals (London Section): "Extensometers." R. H. Greaves, D.Sc. 7.30 p.m.	Institute of Marine Engineers, 85-88, The Minories, London, E.1.
12	Ceramic Society; Proceedings will take the form of a Question Box. 7.30 p.m.	Central School of Science and Technology, Stoke-on-Trent.
13	Institute of Metals (North East Coast Section): "Brazing." A. R. Page. 7.30 p.m.	Armstrong College, Newcastle-on-Tyne.
13	Society of Chemical Industry (Birmingham Section): "The Testing of Resistance to Tearing." H. L. Heathcote. "A Comparative Study of Some Vulcanisation Accelerators." D. F. Twiss and F. Thomas. 7.15 p.m.	University Buildings, Edmund Street, Birmingham.
14	Institution of Chemical Engineers: "Studies in Filtration." B. W. Clarke, S. G. M. Ure, J. W. Hinchley.	
15	Chemical Society: Ordinary Scientific Meeting. 8 p.m.	Burlington House, Piccadilly, London.
15	Institution of the Rubber Industry (Manchester Section): "History of the Rubber Industry in Manchester." John Adamson.	16, St. Mary's Parsonage, Manchester.
16	Chemical Engineering Group: "Low Temperature Carbonisation."	
16	Institute of Metals (Swansea Section): "Alloys and Their Properties." Professor C. A. Edwards. 7.15 p.m.	University College, Singleton Park, Swansea.
16	Society of Dyers and Colourists (Manchester Section): "Note on the Dyeing of Acetyl Silk with Certain Insoluble Azo Colours in *Statu Nascendi*." Professor E. Knecht.	
17	West Yorkshire Metallurgical Society: Annual Dinner.	George Hotel, Huddersfield.
19	Institute of Chemistry (Manchester Section): Social Evening.	
19	Royal Society of Arts: Cantor Lecture: "Radiological Research." V. E. Pullen.	John Street, Adelphi, London.
19	University of Birmingham Chemical Society: Presidential Address. Professor G. T. Morgan. 5.30 p.m.	Chemical Lecture Theatre, Edgbaston.
20	Society of Dyers and Colourists (Leeds Junior Branch): "Chrome Blacks." F. L. Goodall. 5.30 p.m.	
21	Society of Glass Technology.	Birmingham.

MR. D. MILNE WATSON,
Governor and Managing Director of the Gas Light and Coke Co'y.



MR. W. J. U. WOOLCOCK,
President of
Society of Chemical Industry.



SIR JOHN F. BRUNNER, BART.,
President of the Association of
British Chemical Manufacturers.

SIR ARTHUR DUCKHAM,
President of
Institution of Chemical Engineers.

PROFESSOR G. G. HENDERSON,
President of
The Institute of Chemistry.

PROFESSOR W. P. WYNNE,
President of
The Chemical Society.

Photos by Elliott & Fry, Lafayette, Bacon, and A. D. Kissack.

REPRODUCED FROM "THE CHEMICAL AGE" YEAR BOOK FOR 1925.

DR. E. F. ARMSTRONG,
President of the
British Association of Chemists.

MR. A. CHASTON CHAPMAN,
President of the
Chemical Industry Club.

DR. H. HOULSTON MORGAN,
President of the
Oil and Colour Chemists Association.

SIR MAX MUSPRATT, BART.,
Vice-President of the Association
of British Chemical Manufacturers.

PROFESSOR F. G. DONNAN,
President of
The Faraday Society.

MR. VICTOR BLAGDEN,
Chairman of the British Chemical
and Dyestuffs Traders Association.

Photos by Elliott & Fry, Lafayette, Bevan, and A. D. Kissack.

REPRODUCED FROM "THE CHEMICAL AGE" YEAR BOOK FOR 1925.

1924: A Retrospect

Developments in Chemical Industry, Organisation, and Trade

CHEMICAL trade fluctuated greatly during the year now closing. When compared month by month with the corresponding months of last year the figures for both imports and exports of chemicals, dyes, drugs and colours show sometimes an increase and sometimes a decrease. Regarded as a whole, the year has not been particularly good for chemical industry, but in view of the depression which has existed throughout most of the year in the iron and steel and coal trades, chemical manufacturers and dealers may be congratulated upon having so well maintained their activities and profits. Furthermore, reports made during the latter part of the year indicate a satisfactory revival of trade generally.

The stabilisation of German currency—by the adoption of reichsmarks having a gold value in place of the almost worthless paper marks recently in circulation—has facilitated trade with that country. Last year the value of the British pound sterling was expressed in milliards of German marks, the number often fluctuating wildly from day to day; but now its value is approximately 19½ German reichsmarks and the periodical fluctuations remain within narrow limits.

The condition of Russia as an industrial and trading country under the Soviet Government continues to be abnormal, but figures published by the Board of Trade show that during the year we have been exporting or re-exporting to Russian ports machinery, metals, chemicals, hides, wool, raw cotton and other goods of very large aggregate value. Our imports from Russia have also been large. During the first eight months of the year the British imports of lamp oil, motor spirit and lubricating oil from Russia were valued at more than a million pounds.

Slackness in the iron and steel trade naturally caused slackness in the oven-coke industry, and this in turn caused a shortage in benzol supplies from home sources.

The Chemical Societies

There is not much that calls for record this year regarding the prospect of amalgamation of chemical societies or the provision of a Chemistry House for the use of all the societies. The leaders in the chemical world, both academical and industrial, are still endeavouring to devise a workable scheme to provide a building that will be of service to the whole chemical community. With regard to the use of a chemical library, readers may be reminded that several societies are already working together. A letter from Dr. Travers, published in THE CHEMICAL AGE on October 11, pointing out how the lack of organisation resulting in the necessity to pay subscriptions to several societies bears hardly on the younger chemists, was followed by a letter from Dr. Philip, in which he gave some interesting information about the Chemical Society Library. All the leading chemical organisations are now associated with the upkeep and development of the Library, and the number of readers who use it in the course of a year amounts to between six and seven thousand. The fact that a large proportion of the books can be borrowed either directly or through the post makes the Library useful to chemists in all parts of the United Kingdom.

Joint meetings of societies have been frequent during the year, and the election of Mr. Woolcock—an experienced and successful organiser—to the presidential chair of the Society of Chemical Industry will, it is believed, be helpful to the cause of unity and fraternity. In November a joint dinner was held in London by the Society of Chemical Industry and the Chemical Industry Club. There was a large attendance of members and their friends. Speeches were made by a number of distinguished visitors and members, the main themes being the importance of chemistry in modern life and the necessity for greater co-operation between all descriptions of chemists.

During the year an Indian Chemical Society has been founded, with headquarters in Calcutta. Sir Prafulla Chandra Ray is the first president. A congratulatory cablegram was sent from London to Sir Prafulla from the president and Council of the Chemical Society. The founding of this Society may prove to be an event of great historical importance. By its growth and activities the Society may exert a profound influence in the coming decades upon the social life and industrial progress of the Asiatic peoples. Interest in the following paragraph, which occurred in Sir Prafulla's reply to the president of the Chemical Society, will not be restricted to chemists:—"More than 40 years ago, while a student at Edinburgh, I almost dreamt a dream that, God willing, a time would come when modern India would also be in a position to contribute her quota to the world's stock of scientific knowledge, and it has been my good fortune to see my dream materialise. I have shown in my *History of Hindu Chemistry* that this branch of science was zealously pursued in ancient India, and I have now the satisfaction of finding chairs of chemistry in most universities of India filled by my own pupils, who have also been regular contributors to the *J.C.S.*"

The Exhibition

One of the most notable events of the past year was the holding of the British Empire Exhibition at Wembley, near London. The Exhibition was opened on April 23 and closed on November 1. Over seventeen million people passed the turnstiles. This number includes hosts of school children, who, guided by their teachers, gained much information that will be useful in later life. Visitors came in great numbers from all parts of the world, and many of them will return home with a better knowledge of the manufacturing activities of Great Britain and with a better appreciation of the diversity and abundance of the natural resources of the Empire than they possessed when they arrived. The possibility of satisfying nearly all the needs of all the peoples of the Empire by interchange of natural and manufactured commodities must have become apparent to everyone who made a tour of the Exhibition. In the building known as the Palace of Industry the remarkable collection of exhibits relating to chemistry and to chemical industries daily attracted large crowds. Credit is due to the British Association of Chemical Manufacturers for its work in organising a Chemical Section which was worthy of the science and industry it represented. The Exhibition, probably in an altered form, is to be reopened next summer.

Chemistry and the State

Sir Robert Robertson, the Government chemist, was president of the Chemical Section of the British Association meeting which was held in Toronto in August. In a long and interesting presidential address on "Chemistry and the State," Sir Robert showed that chemistry has gradually intruded more and more into State affairs and that various Government Departments are now utilising the services of chemists to a greater extent than ever before for the preparation of war materials, for examination of foods, and for guidance and protection in agriculture. He estimates the number of chemists working in Departments maintained wholly by the State to have been 150 in 1912 and to be 375 at the present time. In establishments to which the State affords partial support, such as those under the Development Commission and the Research Associations, the number was 50 for the year 1912, compared with 150 now employed.

Safeguarding Act

Part II of the Safeguarding of Industries Act, 1921, which refers to "dumping," ceased to operate on August 19 last. This part of the Act was intended to protect all British industries from competition with imported goods bought at prices below cost of production or at prices which, owing to the depreciation of foreign currency, were likely to seriously affect any home industry.

Part I will continue in operation until October 1, 1926. The object of this portion of the Act is to protect certain key industries by imposition of a duty of one-third of the value of the goods on all specified goods imported into the United Kingdom from countries not included in the British Empire. Synthetic organic chemicals are included in the specified goods.

Preservatives in Food

In the Final Report of the Departmental Committee on the use of Preservatives and Colouring Matters in Food, issued in October, it is recommended that the use of preservatives shall

be prohibited in all articles of food and drink, with the exception that sulphur dioxide or benzoic acid limited to specified amounts shall be allowed in certain specified cases. The employment of a copper salt to colour or preserve the colour of peas or other vegetable is to be forbidden if the recommendations are adopted. Formaldehyde and its derivatives, hydrofluoric acid and its derivatives, boron compounds and salicylic acid are all condemned as undesirable in food. In the report the term " preservative " does not include salt, saltpetre, sugar, vinegar, acetic acid, alcohol, spices, or the agents introduced into food by the process of curing known as " smoking."

Scientific Glassware

The report of the Joint Committee for the standardisation of Scientific Glassware on Units of Volume was issued during the year. The Committee recommends that the litre and millitre, or thousandth part of a litre, shall be used as the standard units of volume, and that standard volumetric glassware shall be graduated in terms of these units and marked " ml " instead of " cc."

Also that the unit on Mohr's system shall in future be designated G.W.A. (Grams of Water in Air) and that these letters shall be marked on all volumetric glass vessels graduated on the basis of Mohr's system and shall be used by chemists when reporting results obtained by the use of such vessels.

Also that the G.W.A. unit shall be defined thus :—1,000 G.W.A. = 1,002 ml.

The Committee understands that the National Physical Laboratory will accept for tests vessels graduated on the basis of G.W.A. units and clearly marked to indicate this, and will place a distinctive mark on approved vessels graduated on this system, but not the Laboratory monogram, NP, which will be reserved for vessels graduated in millitres.

Bentonite

In a publication issued in March by the Bureau of Mines, U.S.A., some further information relating to bentonite was given. Bentonite is a clay found in certain of the American States and in Canada. It possesses remarkable colloidal properties. One of its characteristics is its ability to absorb large quantities of water and to form colloidal jelly-like suspensions when mixed with water. Some forms of bentonite do not form these jelly-like suspensions. For bleaching oils bentonite has shown in some tests an efficiency sixteen times greater than that of fuller's earth.

In an article on " Recent Advances in Colloid Chemistry," by Mr. A. V. Slater, published in THE CHEMICAL AGE issued September 13 last, it is stated that one entirely original industry that has resulted from the discovery of bentonite is the de-inking of paper. It has been found that bentonite can adsorb carbon and that a sheet almost equal to the original in quality can be obtained.

Gas Company's Caustic Soda

Judgment was given in January in an action brought by Mr. Deuchar, Secretary to the Castner-Kellner Alkali Co., for a declaration that the manufacture of caustic soda by the Gas Light and Coke Co. of London is *ultra vires*. For the purpose of taking this action Mr. Deuchar became one of the gas company's stockholders.

Mr. Justice Astbury said it was admitted that the company were entitled to make beta-naphthol and to make it with caustic soda as a reagent, and that they were entitled to buy caustic soda for that purpose. The dispute was whether they were entitled to manufacture caustic soda. It was admitted that no sale of caustic soda had been made by the company. The company were in no way setting up as dealers in caustic soda He held that the company were neither doing, nor proposing to do, anything which was *ultra vires*, and the action must be dismissed with costs.

In June an appeal against this judgment was heard in the Court of Appeal, but the judgment was upheld and the appeal dismissed.

Magadi Soda

During the year the Magadi Soda Co., Ltd., went into liquidation, and a scheme proposed by Brunner, Mond and Co. was adopted. Under the scheme a new company of the same name is to be formed, and the Governor of Kenya Colony is always to have a representative on the board of directors. The old company was formed in 1911 to market the soda found in Lake Magadi. This lake contains an immense deposit of solid sesqui-carbonate of soda which, for a natural salt, is of remarkable purity. The old company marketed many thousands of tons of the soda, but its operations resulted in heavy financial loss. If the deposit is to be worked under the control of, or in co-operation with, Brunner, Mond and Co. the prospect will be greatly improved.

London Gas

One of the most important amalgamations in the history of the gas industry is being arranged between the Gas Light and Coke Co. and the Brentford Gas Co. The Brentford Gas Co. has recently absorbed the Richmond Gas Co. and the Harrow and Stanmore Gas Co. The operations of the Gas Light and Coke Co. are already on a larger scale than those of any other gas undertaking in the world. The aggregate calorific value of the gas sold annually by the amalgamating companies is approximately 200 *million* therms. This is equivalent to 40,000 *million* cubic feet of gas having a calorific value of 500 B.Th.U per cubic foot. Much of the new territory to be acquiried by the Gas Light and Coke Co. is likely to become more densely populated during the next decade, and will call for a larger supply of gas. The amalgamation, if effected, is to date from January 1, 1926.

The Bergius Process

Great interest continues to be taken in the Bergius process for producing light oils and heavy oils from coal by heating the coal with hydrogen under high pressure. Similar oils may be produced from heavy asphaltic oils treated in the same way. Some useful information was given in a paper on the subject communicated by Dunstan and Pilkethley to the Institution of Petroleum Technologists in October. It is said that by the Bergius process any coal containing less than 84 per cent. carbon, on a dry and ash-free basis, can be successfully hydrogenated at a temperature of about 400° C. and a pressure up to 200 atmospheres with the production of hydrocarbons similar to petroleum distillates.

Dr. Dunstan referred to the plant which is working at Rheinau. The coal is ground to an exceedingly fine powder and mixed with oil. This mixture can be circulated by pump, and is heated in an autoclave 30 ft. long and 3 ft. in diameter. The heating is effected by passing nitrogen first through coils heated in a furnace, and then through the annular space between the inner chamber and the heavy steel wall of the autoclave. The final pressure reached is sometimes as high as 280 atmospheres. In most processes used for cracking heavy oils trouble is caused by the production of a coke residue, which prevents the plants from being run continuously. Bergius claims to have overcome this difficulty. Experiments made by Dr. Dunstan and others indicate that hydrogenation of the liquid products does not occur when pressures of less than 150 atmospheres are used, but Dr. Dunstan thinks that at higher pressures hydrogenation may occur. In July a company called the British Bergius Syndicate, Ltd., was registered, and the names E. V. Evans, W. R. Ormandy and D. M. Watson are included in the first list of directors. The syndicate is to manufacture, deal with and render saleable, oils and other products obtainable from mineral oils, coal and other bituminous materials.

Lead Tetraethyl

Some time ago it was discovered that when one part of lead tetraethyl is mixed with a thousand parts of petrol the mixture is superior to the petrol alone, because it reduces the engine trouble known as " knocking." This mixture has been in use in certain districts in the United States for some time. But a number of men engaged in the manufacture or the handling of the lead compound are reported to have become insane, and others have died. Consequently the manufacture of the mixture has been discontinued. The New York Board of Health and the New Jersey State Department of Health have prohibited the use of petrol containing lead tetraethyl, and investigations are being made to obtain more knowledge concerning the action of minute quantities of the lead compound upon the various organs of the human body.

Petroleum Supplies

The supplies of crude petroleum and of petroleum products have continued to be very abundant throughout the year. The oil famine which has been predicted for so many years is not yet within sight, although the quantity of petroleum

consumed continues to increase year by year. Reduced quantities of crude oils have been obtained from the oilfields of California, Central Texas and some other localities, but the world's production has been sufficient to meet all demands. During the year new oil wells have been discovered in so many parts of the world that there is no immediate danger of a serious shortage. In Mexico, where the incursion of salt water into the oil wells has attracted so much attention during the last few years, a large number of prolific wells have been opened this year, and the output of oil from Russia, Roumania, Persia, Peru and Trinidad has increased.

The annual report of the Anglo-Persian Oil Co., published last month, stated that further drilling in the Persian main fields has led to a large increase in the extent of the proved oil-bearing territory. Outside the Main Fields oil of high quality has been discovered at Kishm, an island near the entrance to the Persian Gulf. An extraordinary feature of the Kishm oil is that it consists of practically nothing but petrol and kerosene. The chairman, when referring to this discovery at the annual meeting of the company, said that they had been drilling on the island for several years, and had decided to abandon the search there; but some months ago when the casing was being withdrawn from one of the wells the flow commenced, and has continued ever since at a daily rate of 400 to 4,000 gallons. It is too early yet to form a definite idea as to the value of the Kishm field. The same company has struck several good oil and gas wells recently in the Argentine.

A table showing the estimated consumption of petroleum and petroleum products *per capita* in different countries has been published by Mr. Homer Fox, and shows that in the United States the consumption is nearly 226 American gallons, whereas in the United Kingdom it is less than 32 gallons. In Canada the consumption is 81·5 gallons.

The quantity of crude oil imported into the United Kingdom during the year has increased largely beyond the quantities imported in previous years, and affords an indication of the growing importance of the oil refining industry in this country.

Fuel Oil for Ships

The last annual report of Lloyd's Register of Shipping showed that the use of oil as a substitute for coal in steamships is still extending. In July 1914 the gross tonnage of steamers fitted for burning oil was 1,310,209, whereas by July 1924 the tonnage was 17,154,072.

In July 1914 the number of motorships was 297, with gross aggregate tonnage of less than a quarter of a million tons. By July 1924 the motor vessels had increased to 1,950, with a gross tonnage of nearly two million tons.

The increasing demand for fuel oil is tending to bring that portion of the crude petroleum closer in importance to the fraction used as motor spirit. In an article in *The Lamp*, an American journal, it is stated that in 1923 gasolene represented 26 per cent. of the volume of crude oil and fuel oil 57 per cent. The value of the gasoline was 53 per cent. of the total value of the crude oil products, but the value of the fuel oil was only 26 per cent. The large number of plants which are now employed for cracking heavy oils to produce motor spirit reduces the amount of oil remaining for sale as fuel oil.

Oil Tanks and Lightning

In September a report from Rangoon stated that lightning had started a fire in one of the crude oil tanks belonging to the Burmah Oil Co. The fire was confined to its source, and the oil burned itself out. The damage consisted of the loss of the tank and its contents, both of which were covered by insurance.

Kent Coal and Coke

Another important step in the development of the Kent coal industry occurred in May, when a formal commencement was made of the sinking of a shaft at Betteshanger. The pit is being sunk by Pearson and Dorman, Long, Ltd. This firm has acquired the mineral rights under about 60 square miles in Kent. The existence of many millions of tons of coal in this area has already been proved by borings and sinkings.

Early in the year Colonel Standen, president of the Deal, Walmer and District Chamber of Commerce, when addressing a meeting, said that Kent coal is not a house coal, but is suitable for the production of foundry or metallurgical coke. Some seams which have been worked consist of dirty friable coal mixed with shale and carboniferous stone; but some of the seams do not suffer under this disability. The deep seam known as the Milyard seam at Sandown Colliery, which is being worked by Pearson and Dorman, Long, Ltd., is a clean seam 4 ft. 5 in. in thickness, and is, Colonel Standen believes, the finest coal of its class in the world.

Geothermal Power

A paper on the "Larderello Natural Steam Power Plant" was read by Prince Ginori Conti at the annual meeting of the Society of Chemical Industry, which was held in Liverpool in July. It is hardly necessary, said Prince Conti, to explain the importance of the Larderello plant as an entirely novel method of obtaining power which has very appropriately been called "Geothermal."

The history of the development of the chemical industry of the Larderello Works is well known, but the feasibility of utilising natural steam as a means of generating mechanical and electrical power was ignored till the beginning of 1904, when Prince Conti attempted to use natural steam with an engine of small horse-power. The erection of the Larderello Power Station was commenced in 1914. It consists of three turbo-alternators, each of 2,500 k.w. net power. Two are kept running and the third is held in reserve. In Larderello and neighbouring localities a plentiful supply of steam is obtained by drilling wells in the volcanic soil and this steam is used to operate turbines. Sufficient power is obtained to generate the electricity supplied to a number of villages and towns.

Sources of natural steam are abundant in various parts of the world where volcanos are or have been present. The power plant in operation at Larderello is attracting world-wide attention, and searches for steam springs of sufficient power to be useful are being made in many lands.

Silica Gel

Much attention has continued to be given to silica gel as an absorbent and adsorbent. During the year a British company called Silica Gel, Ltd., has been formed to acquire rights and interests relating to silica gel, and especially to acquire the right to use all patented processes belonging to the Silca Gel Corporation.

Home Grown Sugar

It is noteworthy that the late Labour Government, like the preceding Coalition Government, decided to assist in the effort to establish a beet-sugar industry in this country. Speaking in the House of Commons on July 30 last, Mr. Philip Snowden said that he was glad to be able to inform the Committee of Supply that the Government had accepted the principle of Exchequer assistance for the sugar-beet industry. The Government proposed that there should be an excise duty of 9s. 9d. per cwt. of the beet-sugar manufactured in this country, but that there should be a subsidy of 19s. 6d. per cwt. The subsidy might be reduced to 13s. in four years, but legislation would be necessary. A crucial matter was to ensure a sufficient supply of beet at prices that would encourage the producers. The Government, therefore, would fix a subsidy at a figure which would enable the manufacturer to give a price for beet that would encourage the farmer to grow it. Assistance would be necessary for a period of ten years to enable the industry to get on its feet. The Government were assured that if the subsidy were granted six new factories would be started almost immediately. The recently formed Conservative Government has announced its intention of adopting the proposals made by the Labour Government for the grant of a subsidy for the period of ten years, coupled with the condition that a minimum price per ton of beets shall be paid to growers in the initial years. The subsidy is to be 19s. 6d. per cwt. for the first four years, 13s. for the three following years, and 6s. 6d. per cwt. for the three final years. It will thus be seen that all political parties are agreed that aid in some form or other shall be given to those who are endeavouring to establish sugar-beet cultivation and beet-sugar manufacture as permanent industries in different parts of England.

Sulphate of Ammonia

At the last annual meeting of Brunner, Mond and Co., Ltd., the chairman, Mr. Roscoe Brunner, announced that Synthetic Ammonia and Nitrates, Ltd., had started their nitrogen fixation plant at Billingham in December last, and

that the staff was engaged in designing plant for the extension of the output and for the production of ammonium salts other than sulphate.

The annual report of the British Sulphate of Ammonia Federation issued last month states that Synthetic Ammonia and Nitrates, Ltd., is now the largest individual producer of the sulphate in this country, and Mr. Milne Watson, in his presidential address to the Federation, said the company's deliveries had been regular and satisfactory in quality. Referring to India, Mr. Watson said that all the authorities interviewed in India agreed that the application of sulphate of ammonia in India is becoming absolutely necessary if good crops of sugar and cotton are to be regularly obtained. Makers representing nearly the whole of the Indian output have joined the British Federation. In Palestine, a wheat-growing country, arrangements are being made for experiments with sulphate. Propaganda work to popularise the use of sulphate has been started in China under the supervision of Brunner, Mond and Co. (China), Ltd.

Compared with the preceding year, both the home consumption and the export of sulphate have increased. The world's production of sulphate for the year 1923–1924 was about 2,473,000 tons, thus securing for sulpahte of ammonia the premier position among nitrogenous fertilisers so long held by nitrate of soda.

Gifts

During the year a number of Universities have benefited by gifts or bequests. Lord Bearsted gave £10,000 to the University of Sheffield for study and research in the Department of Metallurgy. The late Mr. W. H. Revis left £10,000 and a share in £35,000 to the University of Nottingham. Brunner, Mond and Co. made a gift of £300 to the Department of Physics in the University of Manchester in aid of research. £5,000 was given by Mr. Alfred Lund to the University of Leeds for scholarships in the Clothworkers' Departments; and Mrs. Tyndall, widow of Professor John Tyndall, gave £500 to the Royal Society to meet out-of-pocket expenses of the Tyndall research student during his investigations.

Obituary

Many chemists well known in industrial or academical circles have passed away during the year. The list includes John Allen, G. H. Bailey, H. Kelway G. Bamber, Sir George Beilby, E. Hilton Brown, Sir Charles Cameron, J. M. Collett, Sir James J. Dobbie, W. R. Earp, Otto Hehner, R. Hellon, T. Jamieson, H. G. Smith, R. W. M. Thomson, and J. T. Wood.

The Nitrogen Industry in 1924

By E. B. Maxted, D.Sc., Ph.D.

PROBABLY the most important development in the nitrogen industry during the past year from a British standpoint has been the definite working on a manufacturing scale of the synthetic ammonia plant at Billingham. Details of the technical progress which this factory represents have not been published. The ammonia is, however, removed from the circuit gases by washing with water, and the outside walls of the pressure furnaces are maintained at or below 100° C. Its capacity is 100 tons of ammonia a day, capable of extension to 300 tons. The opening of this factory represents an important milestone in British industrial progress, quite outside the narrow circle of the success or otherwise of a particular business, and tribute is due both to the technical staff and to the financial backing which has made such an enterprise possible.

In other countries also, the technical synthesis of ammonia has made very real strides. Apart from the French agreement with the Badische Co. for the establishment of a nitrogen fixation plant at Toulouse, the Claude system is being installed on a moderate scale in France, Italy, Spain, etc., and the Casale system is being worked at Niagara Falls and elsewhere.

The relatively prosperous condition of the Chile nitrate trade during the greater part of the year has been due rather to business agreements than to improved technical methods of extraction, although these are being gradually introduced, while in another branch of the nitrogen industry, the movement towards neutral ammonium sulphate is rapidly growing; and the time is probably not far distant when only neutral sulphate will be produced. On the whole, the more settled conditions in Europe are having a beneficial effect on the establishment of the newer nitrogen industries. The boom of the war has of course disappeared; but it would seem, all the same, that the lowest point of the wave of industrial depression, which has also affected the nitrogen industry, has now definitely been passed, and that new confidence in the political future, and in stable conditions on the Continent, is reflected in many new industries, particularly for the fixation of nitrogen, which are now coming into being. Much of the work connected with these newer enterprises necessarily remains unpublished. However, of the publications during 1924, contributions of particular importance have come from the American side. A short reference to the principal papers and patents of the year is given below:

Synthesis of Ammonia

Further details of the semi-large synthetic ammonia plant at the Fixed Nitrogen Research Laboratory at Washington have been given (*Chem. and Met. Eng.*, 1924, *30*, 948; *The Chemical Age*, Vol. XI, p. 7). The unit has a capacity of ¼ ton per day and employs electrolytic hydrogen, which is burnt with the requisite quantity of air to produce a 3 : 1 mixture of hydrogen and nitrogen. Note may be made of the use of charcoal to absorb traces of oil from the compressor. Two important general articles on the synthesis of ammonia have appeared, by F. G. Cottrell (*The Chemical Age*, Vol. XI, pp. 282, 310 and 342), and by E. Kilburn Scott (*The Chemical Age*, Vol. X, p. 482). In the first of these, the direct synthesis of ammonia and its relation to other methods of nitrogen fixation, particularly in America, are discussed in detail and a number of photographs are given. Special attention is paid to American catalysts. Kilburn Scott deals principally with the construction of various types of ammonia furnaces, the construction of reaction chambers of the Haber, Claude, and Casale types being dealt with in some detail. An interesting feature in some of the Claude bombs is the provision of a cover fixed by means of an interrupted thread, as in the breach of a gun. For further descriptions of pressure furnaces, reference may be made to British Patent No. 208760 (Badische Anilin und Soda Fabrik, *The Chemical Age*, Vol. X, p. 121) in which the use of large self-supporting resistance elements, which can easily be removed from the plant, is described, also to the patents of L. Casale (U.S. Pat. 1478549 and 1478550). Before leaving the subject of ammonia plant, the proposal of L. Casale (Brit. Pat. 221956; *The Chemical Age*, Vol. XI, p. 427) to use as a means of circulation the injector action available during the introduction of fresh gas may be mentioned This simplification of the synthesis by the avoidance of externally actuated circulating pumps is undoubtedly of importance; but its efficacy must necessarily depend on the conversion per passage which will control the amount of fresh gas which has to be added. It is probably less suitable for rapid circulation systems than for a process which aims at a relatively high conversion during each passage of the gas over the catalyst.

Of the various catalysts which have been proposed, iron containing promoters continues to hold the most important place. New modifications in the preparation of these include the treatment of a compound of the iron group, such as ferric or ferrous chloride with dry potassium cyanide in liquid ammonia, following which the excess of ammonia is evaporated, and the residue heated in a non-oxidising atmosphere (Brit. Pat. 218992; *The Chemical Age*, Vol. XI, p. 271). C. Lamb (U.S. Pat. 1489497) mixes with the iron catalyst about 2 per cent. of an alkaline or alkaline earth hydroxide and 2 per cent. of an acidic body for instance silica or alumina. This is a very slight deviation only from older practice. The same remark applies to the addition of 10 per cent. of an oxide irreducible by hydrogen to iron, which is treated with oxygen in the well known manner before being used as a catalyst. As a further variation of iron catalysts, a product made by heating iron cyanide with aluminium compounds has also been described (Ger. Pat. 397933). These are stated to work at relatively low temperatures.

Of non-ferrous catalysts, magnesium or beryllium cyanamide, prepared by heating the carbonate to 500° C. in ammonia, has

been proposed, but even here the admixture of iron or another heavy metal (J. C. Clancy, U.S. Pat. 1473544) is recommended. The use of lithium either as such or as the nitride or amide is dealt with by C. Urfer (Brit. Pat. 199025). Lithium and the alkali metals suffer of course from the disadvantage that they are destroyed by moisture in the circuit gases. In view of the poisonous action of mercury in many cases of hydrogenation catalysis, the production of ammonia by passing the component gases through a mixture of osmium and mercury at a temperature below the boiling point of mercury is of interest (S. L. Tingley, U.S. Pat. 1495655), and, for a recent summary of ammonia catalysts, the article of Larson (*The Chemical Age*, Vol. XI, p. 463; *J. Ind. and Eng. Chem.*, 1924, *16*, 1002) should be consulted. Composite promoters such as potassium aluminate are specially recommended, and give higher yields than those calculated additively on the basis of the addition of potassium oxide and alumina separately.

Considerable new work on the purification of the gases for the synthesis has been published during the past year. Thus, Brunner, Mond and Co. (Brit. Pat. 215789; *The Chemical Age*, Vol. XI, p. 101) pass the gas mixture through anhydrous liquid ammonia. The method leads particularly to the removal of water and carbon compounds. A step further in this direction consists in the use of a solution of sodium in liquid ammonia for the same purpose (J. W. Cederberg U.S. Pat. 1478889). It is stated that all the ordinary impurities may be removed in this way at a temperature between −20 and +20° C., the absorbent being used at the pressure employed for the synthesis. The method of purification described should be very efficacious if catalysts which are destroyed by water are to be used for the synthesis. Purification by calcium carbide, followed by soda lime has also been described (J. C. Clancy, U.S. Pats. 1483411 and 1483413) with especial reference to the use of catalysts containing cyanamides for the main synthesis of ammonia. Any acetylene generated by the action of moist gases on the calcium carbide is stated to assist the re-formation of cyanamides in the catalyst.

A further point of permanent and fundamental interest is the value of the ammonia equilibrium constant, especially at very high pressures. For this reason, the very complete work of A. T. Larson and R. L. Dodge (*J. Amer. Chem. Soc.*, 1923, *45*, 2918; Larson, ibid. 1924, *46*, 367) will be welcomed. The entire range of pressures from 10 to 1,000 atmospheres has been covered, and the work, besides forming an important supplement to the earlier determinations of Haber and his collaborators, is valuable as extending our knowledge of these constants to the very high pressures used in the Claude system. It is interesting to note that the equilibrium constant itself (apart from the equilibrium percentage of ammonia) increases with increase of pressure. The equilibrium percentage of ammonia at 450° C. and 1,000 atmospheres is almost 70 per cent. by volume. A paper by W. Moldenhauer (*Chem. Zeitg.*, 1924, *48*, 233) may be noticed in conjunction with the above determinations. Moldenhauer has compared the yields obtained by Claude with the theoretical values calculated from Haber's equations, and finds that Claude's yields at pressures above 500 atmospheres and at relatively low temperatures are above those calculated on theoretical grounds. Moldenhauer ascribes this to probable differences in compressibility, at high pressures, between ammonia and the permanent gases.

Other Methods of Nitrogen Fixation

As far as can be judged by published information, relatively little new work has been done on the other two main methods of nitrogen fixation, namely by the arc and cyanamide processes respectively, although several papers and patents dealing with the production of cyanide have appeared. Thus, apart from the Bucher process, the often discussed preparation of alkali cyanides at very high temperatures is dealt with afresh in Brit. Pat. 216198 (*The Chemical Age*, Vol. 10, p. 680), in which it is proposed to add alkali to the air blast used for the production of steel.

Various process details in connection with the Bucher method of nitrogen fixation are described in U.S. Pat. 1473826. The treatment of the cyanised briquettes with carbon dioxide, whereby the cyanide is evolved as hydrocyanic acid, and the alkali re-converted to carbonate—which is ready for further use in the nitrogen fixation reaction—is of interest.

In spite of the corrosive action of barium cyanide at the temperatures which have to be used for its formation, the formation of this cyanide continues to receive attention. P. Askenasy (Ger. Pat. 382041, ex. *J. Soc. Chem. Ind.*, 1924, *43*, 94B) recommends the use of carbon relatively free from ash, such as petroleum coke. It will be remembered that, in former annual reviews, petroleum coke has been stated to be probably the most suitable form of carbon also for the Bucher process. According to Askenasy's directions, the carbon is heated to a high temperature, and may be treated with oxygen or chlorine before being used for the reaction. A patent dealing with the formation of barium cyanide by the interaction of finely divided barium oxide and methane has also been published (Ger. Pat. 361864, ex *J. Soc. Chem. Ind.*, 1924, *43*, 133B). A further patent dealing with the same subject is that of C. Deguide (U.S. Pat. 1501840), in which barium silicate is added to the mixture in proportions sufficient to ensure the production of an infusible mixture. The action of the mass on the furnace walls under the ordinary conditions of nitrogen fixation as barium cyanide is due largely to the melting of the charge.

Experiments on the arc process have been described by E. D. McCollum and F. Daniel (*J. Ind. and Eng. Chem.*, 1923, *15*, 1173). In view of the previous emphasis of the necessity for using a high tension arc, it is interesting to note that the yield of nitrogen oxides per kilowatt-hour was found to increase with the voltage up to 5,000 volts, but a still higher voltage did not give an increased yield. In these experiments silica gel was used as an adsorbent for the nitrogen peroxide produced.

Ammonium Salts

The possibility of an increased yield of ammonium sulphate as a by-product during the carbonisation of fuel forms a latent source of fixed nitrogen, the importance of which can hardly be over-estimated. Apart from low-temperature processes in which a large excess of steam is used, such as that used for the production of Mond gas, the yield of ammonia is relatively small compared with the amount of nitrogen available in the coal gasified. This subject continues, as is natural, to receive attention (see, for instance, *The Chemical Age*, Vol. 10, p. 217).

Another feature of continued industrial interest is the production of neutral ammonium sulphate. A valuable summary of recent developments in by-product ammonia manufacture has been contributed by P. Heigham (*The Chemical Age*, Vol. 10, p. 669). The movement towards neutral sulphate is dealt with at length, and various types of processes are described. The method of drying receives special attention. A somewhat similar description of plant used in ammonium sulphate manufacture is due to S. Stonier (*Gas World*, 1924, *80*, Coking Section, p. 15), neutralisation being carried out by spraying. T. Nicholson (Brit. Pat. 209561; *The Chemical Age*, Vol. 10, p. 173) has protected a special method for obtaining a relatively coarse granulated product. For details of the plant, reference should be made to the original specification or to the abstract quoted.

Ammonium salts other than the sulphate have received less attention during the period under review. The formation of ammonium sulphite, which may subsequently be oxidised to sulphate, forms the subject of a patent specification of J. H. West (Brit. Pat. 215470; *The Chemical Age*, Vol. 10, p. 628). The salt is formed by the direct interaction of sulphur dioxide, steam, and air, which should for economy of working be regulated to the proportions stated in the specification.

Nitric Acid and the Nitrates

While, for the oxidation of ammonia to nitric acid, platinum in the form of gauze is the most widely employed catalyst, the use of palladium has once more been examined. E. Decarrière (*Bull. Soc. Chim.*, 1924, *35*, 48) confirms the observation that palladium is less satisfactory than platinum, although, with relatively high concentrations of ammonia, it may even be more efficient. A catalyst consisting of a mixture of lead oxide with an oxide of manganese, vanadium, molybdenum etc., and an alkaline earth has been proposed by G. Kassner (Brit. Pat. 213571; *The Chemical Age*, Vol. 10, p. 602.) If used at 500–700° C., catalysis takes place without absorption of oxides of nitrogen. Further details are contained in a paper by the same author in the *Zeitschrift f. angew. Chem.* (1924, *37*, 373).

Passing to the general technique of ammonia oxidation, the use of colloidal silica for the absorption of nitrous gases in

the presence of water vapour and air is described by the Farbenfabrik vorm. F. Bayer and Co. (Brit. Pat. 211845; *The Chemical Age*, Vol. 10, p. 470.) Nitric acid of a concentration of 80–90 per cent. can be obtained on heating. In all processes in which nitric oxide is produced as a primary product at high temperatures, the question of the destruction of part of this by the metallic or other walls of the apparatus is a matter of considerable interest. For this reason, the experiments of E. Muller and H. Barck (*Zeitschr. f. anorg. Chem.*, 1923, *129*, 309) may be noted. It was shown that silver has no action up to 700° C., while copper and iron decompose nitric oxide readily even at 500° C.

The second stage in the oxidation of ammonia consists in the conversion of the primarily formed nitric oxide to nitrogen peroxide. Briner, Pfeiffer and Malet (*J. Chim. Phys.*, 1924, *21*, 21, 45) find that the velocity of the reaction increases on cooling below room temperature. Contrary to earlier statements, the velocity was not found by these investigators to be increased by the presence of porous catalysts, provided that the gases are dry. The reaction between nitrogen peroxide and lime is treated by J. R. Partington and F. A. Williams (*J. Chem. Soc.*, 1924, *125*, 947). For the decomposition temperatures and other properties of the system, the solid phase of which consists of calcium nitrate, nitrite and calcium oxide or hydroxide, reference should be made to the original paper. Additional work on the concentration of nitric acid and on the properties of the system nitric acid/sulphuric acid/water has been contributed by T. A. Babor (*Chem. and Met. Eng.*, 1924, *31*, 260). Curves are given showing the vapour pressure of various mixtures.

Turning to the nitrates, a cyclic process for the conversion of sodium into potassium nitrate has been proposed by J. Michael and Co. (Brit. Pat. 208114; *The Chemical Age*, Vol. 10, p. 174). An excess of sodium nitrate is added to a boiling solution of potassium sulphate. Sodium sulphate is precipitated and removed. The liquor is then cooled, when potassium nitrate crystallises out. Potassium sulphate and sodium nitrate are added again in cycle. A somewhat similar proposal for the preparation of potassium nitrate from potassium chloride and magnesium nitrate under special conditions is contained in Ger. Pat. 390394 (ex. *J. Soc. Chem. Ind.*, 1924, *43*, 420B).

Developments in Heavy Chemicals in 1924

By P. Parrish, A.I.C., M.I.Chem.E.

TRADE in heavy chemicals during 1924 has been somewhat characteristic of the two preceding years. At times there has been cause for satisfaction and hope; at other periods there has been something akin to depression. When it was suggested in last year's review that "the greatest need to-day is a return to peace," it was appreciated that so long as the attitude of France in the matter of the Ruhr persisted, the industrial position could not substantially improve.

Fortunately, governments—not alone in this country, but on the Continent—change, and there is reason to believe that the Anglo-German Treaty (1) recently published, marks a distinct step forward towards the restoration of normal trade relations throughout Western Europe. Conscious now that matters generally will be considered in terms of peace, the vistas beyond cannot fail to possess a hopeful aspect, and it is anticipated that the forthcoming year will have better things in store.

The British Empire Exhibition (2) has served a useful purpose in the encouragement of inter-Empire and inter-world trade, and it is a matter for congratulation that the Government has deemed it expedient to continue the Exhibition in a modified form for another year.

Heavy Acids

Sulphuric Acid.—In the last two reviews, the eminent suitability of spent oxide as a raw material in the manufacture of sulphuric acid has been emphasised, and, indeed, its increasing use for this purpose has been the subject of definite comment. Equally, observations have been made concerning the sensible increase in the employment of Sicilian thirds sulphur. Evidence of the correctness of these statements has been forthcoming in the figures published in an article entitled "The Facts About Sulphuric Acid Production" (3).

Whereas in 1913 800,000 tons of pyrites, 110,000 tons of spent oxide, and 3,000 tons of sulphur represented the raw materials used in the production of sulphuric acid, for the year 1923–1924 (ended June 30 last), the consumptions were 350,000 tons of pyrites, 148,000 tons of spent oxide, and 66,000 tons of sulphur. The limit to the production of spent oxide depends on the quantity of coal carbonised, and on the content of sulphur in the coal. Prior to the war, approximately 7 lb. of sulphur were recovered per ton of coal carbonized; in 1917, the figure reached 17 lb. To-day, about 11 lb. are recovered. If all the coke oven gas in this country was freed from hydrogen sulphide, the quantity of spent oxide produced would not fall far short of 200,000 tons per annum.

A development (4) of the future will be the use of additional quantities of zinc concentrates in this country, the sulphur content of which will be utilised in the manufacture of sulphuric acid. The importance of the spelter industry is universally acknowledged, and its establishment on a larger scale than has hitherto been possible will be generally welcomed. Indeed, it would appear that a policy fraught with immense potentialities to the British Empire is to be pursued, as a new era is adumbrated by Mr. W. S. Robinson (5), of the National Smelting Co., Ltd., not only for the British mineral and metal industries, but for the chemical and allied trades.

Definite attempts have been made for many years to design sulphuric acid plant for intensive production at a minimum of capital cost. Developments in this connection have been reviewed (6), and (7) during the year, and it is known that the time factor in sulphuric acid production has been reduced from 144 minutes in the old chamber system to approximately two minutes in the Schmiedel roller box and Metro bubbler tank systems. The underlying principle of these new intensive plants is to secure intimate and positive contact of the burner gases with nitrous vitriol. Such contact may be obtained by the passage of gases through a light seal of nitrous acid, with stirring in addition, or by the creation of a mist of nitrous vitriol by the operation of undulated rollers run at a high peripheral speed. One of the salient features is that burner gases of low or high sulphur dioxide concentration, hot or cold, can be dealt with with apparent impunity.

Another intensive system is that of E. A. Gaillard, of Barcelona (8), which has been put into operation on the Continent, and which will undoubtedly assume significance in this country. Briefly, this system consists of tower chambers, of a slightly truncated form, with the greatest diameter at the top. Burner gases are passed through a curtain of acid, created by the operation of a turbo-disperser, placed in the centre at the top of each tower. A production as high as 40 kilograms of 53° Bé. acid per m_3, per 24 hours, is reported.

Despite the foregoing intensive systems, many chamber plants, based on well-established principles, continue to be built and renewed. Attention is almost invariably devoted to the method of supporting the lead, so as to attain maximum dispersion of heat; to the provision of water sprays; and to the arrangement of chambers on the lines indicated in Fig. 4, in "Developments in the Manufacture of Sulphuric Acid" (9). Interesting particulars are afforded concerning the Mills-Packard chambers (10), the success of which still continues uninterruptedly.

Whenever the subject of burners for the combustion of sulphur material, either in the form of brimstone, spent oxide, pyrites, or zinc concentrates, is raised, one cannot but view the

(1) CHEMICAL AGE, Vol XI, p. 592.
(2) *Ibid*, Vol. X, p. 312.
(3) *Ibid*, Vol. XI, pp. 339–340.
(4) *Ibid*, Vol. XI, pp. 591–592.
(5) CHEMICAL AGE, Vol. X, p. 392.
(6) *Ibid*, Vol. X, p. 310.
(7) *Ibid*, Vol. X, pp. 317–318.
(8) *Chimie et Industrie*, Vol. XI, No. 4, April, 1924.
(9) CHEMICAL AGE, Vol. XI, p. 317.
(10) *Ibid*, Vol. XI, p. 213.

matter from two angles, namely, hand or mechanical operation. Mechanical rabbling invariably results in the creation of dust. This problem has evoked much comment, (11), (12), (13), and (14) concerning the merits and demerits of hand and mechanical burners. The sequel of this discussion led to information being elicited concerning the Bracq-Laurent furnace, which has attracted attention on the Continent. This is the only mechanical burner embodying principles which are calculated to circumvent the creation of dust. In this furnace, the hearth is continuous, and of helicoidal form. A central shaft with arms having rabbles is provided. The shaft is raised and the rotation reversed at pre-determined intervals. The arms travel to the extent of 240° before being automatically reversed. Obviously, with a continuous travel for the material undergoing combustion, the prolific cause of dust creation is eliminated. That more will be heard of the Bracq-Laurent burner in the future goes without saying.

Interesting particulars concerning the concentration of sulphuric acid (15) have been published.

The changes which have taken place in the contact process have been set out by F. C. Zeisburg (16), in a lecture delivered at the Carnegie Institute of Technology, at Pittsburg.

Hydrochloric Acid.—Some trading problems relating to salt (17) are outlined. Zahn plants for the production of hydrochloric acid by the continuous application of sulphuric acid and salt to a cast iron pot heated by producer gas have been erected in this country, and it need hardly be said that working results are awaited with interest. The economics of the production of synthetic hydrochloric acid have been dealt with (18).

G. Poma and G. Andreani, French Pat. No. 556225, cover plant for the production of synthetic hydrochloric acid, and its absorption. The distinctive feature of this patent appears to lie in the burner, which is divided into two parts, one receiving the fuel charge while the other serves as a reception chamber for the gaseous chlorine, etc., required in the reaction.

A paper containing much valuable information on the handling of hydrochloric acid was read by D. M. Newitt, B.Sc. (19), before the Institution of Chemical Engineers. Ebonite and asphalt soften, and become plastic above certain temperatures, while stone and ceramic materials are liable to crack as the result of sudden changes of temperature and pressure. Rubber-lined tanks, which can be vulcanised by superheated steam *in situ*, are being increasingly used, and their suitability appears to be well-established.

Nitric Acid and Nitrates.—The inquiries instituted concerning the Oppau explosion (20) and (21), and the more recent explosion at Nixon, New Jersey, reveal that our knowledge of the explosibility of nitrate of soda is far from complete. Blasting is generally believed to be the cause, and this method of breaking the solid materials containing nitrates should be finally abandoned. It will be recalled that the salt referred to is either a mixture or a double salt of NH_4NO_3 and $(NH_4)_2SO_4$. German authorities regard the mixture only as explosive.

The use of acid-resisting iron, particularly "Ironac," as applied to plants for the manufacture of nitric acid, is the subject of an interesting article by S. J. Tungay (22). An aspect of singular interest—"Do small plants pay?"—is discussed.

Fertilisers and Superphosphates

Some recent problems, having reference to phosphatic fertilisers, are discussed in detail (23). The availability of phosphoric acid to a plant depends on a great variety of different factors, such as the chemical and mechanical nature of the soil, previous crops grown and fertilisers used for them, and the crop now being grown.

A new phosphatic fertiliser—Sulfurophosphate (24)—is described. Some idea of the plant used, and the scale of operations on which the manufacture is conducted, in America, is afforded in a peculiarly interesting article by A. Ogilvie, A.M.I.M.E. (25), on American practice in the superphosphate industry. It is suggested, in compounding manures, that the Americans are ahead of us. They employ high-grade machinery for the purpose, and their mixing plants are practically automatic, and designed for large capacities. Plant capable of 1,000 tons of mixed fertiliser per day is not uncommon.

A modern British superphosphate plant (26), with details of mechanical handling devices, is the subject of a descriptive article. T. P. Colcough, M.Sc. (27), deals in an informative way with the constitution of basic slag.

Information of a valuable character, bearing upon the bulk storage of calcium cyanamide(28), can be drawn from the results of a study concerning the nature and extent of the decomposition of this product under various conditions by the Fixed Nitrogen Laboratory, of Washington.

Synthesis of Ammonia

In a series of articles, Dr. F. G. Cottrell (29), of the Fixed Nitrogen Laboratory, Washington, has made an illuminating survey of the nitrogen fixation problem, dealing, among other aspects, with developments in connection with the cyanamide process, progress in the study of catalysts and promoters for use in the direct process, the problem of temperatures and pressures, and the scope for simplification and economy. It is pointed out that over 60 per cent. of the cost of producing ammonia is ordinarily debitable to producing and purifying hydrogen, and it is suggested that in the present stage of development this is undoubtedly a part of the process admitting of the greatest economy in the curtailment of costs. This view is further enunciated in a paragraph bearing upon the Billingham synthetic ammonia process (30).

There are two phases of the synthetic ammonia process—one, the production of ammonia, and the other its combination with acid, so as to yield a stable product. Sulphuric acid as such is generally too expensive. The Billingham plant produces sulphate of ammonia *via* anhydrous calcium sulphate (31) at less than half the price at which sulphuric acid is being sold. Can carbon dioxide be used? This is a problem which is engaging attention both here and abroad. Neither ammonium carbonate nor carbamate is in itself suitable, but they may be converted into urea—an ideal fertiliser—by the application of heat in an autoclave. Unfortunately, this reaction does not proceed to completion. As, however, the cost of production does not lie in the raw materials, but in the operation, there is adequate scope for the exercise of resource and ingenuity, and other valuable qualities. The dictum of last year can still be repeated: "*A process for the economic production of urea is badly needed.*"

Ammonia and Ammonium Compounds

The caking of neutral sulphate of ammonia (32) has again been the subject of discussion. It undoubtedly raises a large question, but what was outlined in last year's review can only be repeated. Complete neutrality, freedom of the salt from foreign matter, greater crystal size, and storage under conditions where the deposition of moisture (dew) is impossible, are the salient factors to which attention should be directed.

The subject of by-product ammonia manufacture has been dealt with in two important contributions by P. Heigham (33) and Dr. G. Weyman (34) during the year. Bearing on the suggestion that sulphate should only be dried down to that point at which it is in equilibrium with the atmosphere, it should be remarked that experience of neutral, dry, sulphate of ammonia under various hygrometric conditions, resulting from systematic observation, reveals that humidity conditions must be faced as a problem to be circumvented. This is undoubtedly one of the problems of the future. Important

(11) CHEMICAL AGE, Vol. X, p. 349.
(12) *Ibid*, Vol. X, p. 413.
(13) *Ibid*, Vol. X, p. 457.
(14) *Ibid*, Vol. X, p. 487.
(15) *Ibid*, Vol. X, p. 641.
(16) *Ibid*, Vol. X, p. 611.
(17) *Ibid*, Vol. X, p. 318.
(18) *Ibid*, Vol. XI, p. 115.
(19) *Ibid*, Vol. X, p. 192.
(20) *Ibid*, Vol. XX, pp. 399 and 408.
(21) *Ibid*, Vol. XX, p. 505.
(22) *Ibid*. Vol. XI, Metallurgical Section, pp. 25–27.
(23) *Ibid*, Vol. X, pp. 84–86.
(24) *Ibid*, Vol. X, p. 86.
(25) CHEMICAL AGE, Vol. X, p. 288.
(26) *Ibid*, Vol. XI, p. 212.
(27) *Ibid*, Vol. XI, Metallurgical Section, p. 18.
(28) *Ibid*, Vol. XI, pp. 155–156.
(29) *Ibid*, Vol. XI, pp. 282, 310 and 342.
(30) *Ibid*, Vol. XI, p. 569.
(31) *Ibid*, Vol. XI, p. 569.
(32) *Ibid*, Vol. IX, p. 622, and Vol. XI, p. 437.
(33) *Ibid*, Vol. X, pp. 669–670.
(34) *Gas World*, Vol. LXXXI, pp. 417–420.

papers bearing on the properties of crystallising solutions, the application of crystallising processes, uncontrolled and controlled crystallisation, were read at the Chemical Engineering Conference (35), by H. Griffiths, B.Sc., and Dr. T. V. Barker, M.A.

Cyanides

The slump in ferrocyanide prices has been extraordinary (36). Sodium prussiate in 1920 was realising 1s. 8d. per lb. At the commencement of this year 6d. per lb. was the market price, and to-day 4d. per lb. obtains. The recovery of ferrocyanides from spent oxide is still a process which is operated in this country and on the continent, but unfortunately, the industry is under a cloud at the moment, for reasons indicated above.

Soda and Potash Salts

An article elaborating the position of the Solvay ammonia-soda process (37) in relation to the electrolytic caustic soda process has been published. The development of the latter method depends essentially on the ability to evolve additional uses and markets for secondary products, involving the use of chlorine. In this connection the de Vains process for the production of cellulose by the utilisation of chlorine is a development which will be followed with keen interest. The future will doubtless pronounce judgment on two processes in which chlorine is utilised in the manufacture of cellulose. These processes have been the subject of much controversy (38). Special advantages are claimed for the Cataldi-Pomilio process, whereas distinctive features are said to be possessed by the de Vains process. What appears certain is that both admit of the production of pure and cheap cellulose, by methods more efficient from a technical point of view than the older one. Further, they afford a much needed outlet for chlorine, large and increasing quantities of which arise from the electrolytic process.

Informative articles relative to the electrolysis of a saturated solution of brine (39) and (40) have been published from time to time, and the manufactures of bleaching powder, liquid chlorine, and the layout of an electrolytic caustic soda plant have been enlarged upon. The possibilities in electro-chemistry (41) have been outlined and foreshadowed. As regards electrolytic cells, the important technical considerations to which attention should be directed are: space occupied per cell, current efficiency, energy efficiency, and analysis of cathodic liquor.

It is not unlikely that the Magadi Soda Co., Ltd. (42), a firm formed to work the concession of a soda lake in Kenya Colony, will come under the control of Brunner, Mond and Co., Ltd.

It is hoped that 1925 will witness a steady and continuous improvement of trade, and thus afford opportunities for the application of improved plant and processes.

(35) CHEMICAL AGE, Vol. XI, p. 442.
(36) *Ibid*, Vol. XI, p. 438.
(37) *Ibid*, Vol. X, p. 666.
(38) *Chimie et Industrie*, Vol. XI, No. 6, Juin 1924.

Progress in the Lime Industry in 1924

By N. V. S. Knibbs, B.Sc., etc.

IN this first annual review of progress in the lime industry it is necessary briefly to survey the general condition of the industry in recent years and to give some of the reasons for its backwardness.

Progress in the lime industry of Great Britain has been rapid during the last two or three years, but this rapid development followed a long period of stagnation which persisted until 1920. By stagnation it is not implied that there was any depression in trade, although before the war competition at times became uncomfortably acute. The stagnation was in the matter of improvements in the manufacture and uses of lime. The mixed feed kiln—then almost universally employed—is well adapted to the use of cheap fuels, and if well designed its fuel efficiency is fairly high. Consequently, as long as the users of lime were content to purchase the impure and variable product of the mixed feed kiln, there was little incentive to the lime-burner to improve his methods of manufacture, except, perhaps, in the direction of fuel economy. The mixed feed kiln has been improved and increased in capacity, but its inherent defects of the close association and combination of lime and fuel and the variability of the lime produced cannot be eliminated.

It must be confessed that the users of lime are largely responsible for the backwardness of the lime industry. Indeed, it has been necessary to educate the consumer to an appreciation of the value of high grade lime and of lime in the convenient form of hydrate. This applies particularly to the agriculturist and builder, but it is also surprising how many firms engaged in chemical manufacture purchase lime by gross weight and not on the available lime unit, and often without even checking the purity of the material purchased. Those that do sample and analyse their lime often know little of the cost of using the particular product they buy, and frequently they could effect an economy by using a purer lime or a hydrate. The leather industry affords an instructive example. Some of the largest and most up-to-date tanners have proved conclusively that it pays them to use hydrate instead of lump lime in the depilation pits, yet the majority of tanners still employ lump lime because it is cheaper in first cost. The extra labour of slaking it and measuring or weighing out the slaked material, the loss due to impurities, and the irregularities of working due to the variability of lump lime, heavily outweigh the saving in first cost, but in the absence of detailed costing the leather manufacturer is apt to lose sight of these charges.

Turning now to progress made during 1924, it must be explained that many lime manufacturers are reluctant to give any information about their plants or processes, and therefore no progress review can be claimed to be complete. Nevertheless, since poverty or inefficiency of equipment is generally at the root of this reluctance, it is improbable that anything of importance is neglected.

Nothing of outstanding importance has been achieved in the chemistry of lime. The chemical department of the National Lime Association of America continues its valuable work, but they have not published anything in the technical press during 1924.

Two new types of gas-fired kilns have been completed and put into operation. The first of these to be operated consists of a large mixed feed kiln adapted to gas firing. The diameter of this kiln is much too great to permit the penetration of the gas to the centre from outside gas ports, and to overcome this difficulty the interesting experiment has been tried of providing a central steel shaft fire-brick-lined on the outside. The stone therefore descends through an annular space sufficiently narrow to ensure thorough penetration by the gas used in calcination. This kiln has not been in operation for a long enough period to know what is to be expected of it finally, but it has been so far successful as to focus considerable interest upon its future performance.

The second type of kiln has been adopted in a plant of four kilns of an estimated total capacity of 1,000 tons lime a week. It consists of an ordinary shaft kiln, changing from circular to rectangular section near the bottom and fired by gas made in four small producers attached to the sides of the kiln. The gas passes directly from the producers into the kiln, and therefore the burning out of gas mains—a drawback of the kilns fired by gas made in ordinary producers—is eliminated. These kilns have started well, but here again it is too soon to speak of their normal performance.

The largest hydration plant in Europe was put into operation early in the year at a well known plant in the west of England. The construction and operation of so large a plant is significant of the progress of lime manufacture in this country.

Little more remains to be said. The demand for hydrate and for pure lime grows as the pioneer work of up-to-date producers bears fruit. The users are still very conservative, but the change, for being slow, will be all the more sure, and we may look forward with confidence to further progress in 1925.

(39) CHEMICAL AGE, Vol. XI, pp. 114–117.
(40) *Ibid*, Vol. XI, p. 346.
(41) *Ibid*, Vol. XI, p. 79.
(42) *Ibid*, Vol. X, p. 381.

The Fine Chemical Industry of 1924

By A. S. Wilson-Jones, B.A.

A review of the Fine Chemical Industry published a year ago in this journal (December 29), showed that since the war this industry had much expanded in this country, and it is satisfactory to record that during the past year the progress made has been further consolidated; in fact, in some directions new products have been developed, and are appearing in the market. It is, however, not possible to generalise to any extent about the fine chemical industry, asthe field covered is so wide and different conditions obtain in different sections.

Some Good and Bad Features

Manufacturers who have undertaken to supply certain dyestuff intermediates would seem to have been in the least happy position. The demand for dyes has been steady, but not so large as was expected a few years ago, so that where special plant has been installed for the production of a particular dye intermediate, it is in some cases lying idle, the dye manufacturer being able to supply his needs from stock. The more commonly used dye intermediates, however, have had a satisfactory demand. Salicylic acid in particular has been manufactured in large quantities, and this fact seems incidentally to be one of the strongest in favour of the Safeguarding of Industries Act. Manufacturers state that they embarked on the production of salicylic acid owing to the encouragement offered by the protective duty, and though at first they could hardly produce at an economic selling price, in course of time the efficiency of manufacture was gradually increased, so that at the present time the Act may be said to have achieved its purpose. During the past year, it is stated, very little salicylic acid has been imported from abroad; but, on the other hand, considerable amounts have been exported and sold in the Canadian market.

With regard to the position of other products under the Safeguarding Act, some would seem to approximate to that of salicylic acid. On the whole, the protection is of greater value with the more expensive substances as the duty on these has a greater absolute value, which is thus more likely to cover the high labour costs in this country. With some materials the effect of the Act has again been practically nullified by the depreciated currencies of some of the Continental countries, more particularly the French. Generally speaking, however, British manufacturers are wholehearted in their support of the Act, and look to its continuance beyond the original period of five years.

Some firms, however, have experienced such an increased demand for their fine chemical products that they have had to enlarge their factories. The British Drug Houses, for example, have, during the year, erected a building of 11,000 sq. ft. equipped on modern lines and another of 3,000 sq. ft. is now under construction.

Insulin

The production of insulin on a commercial scale was a notable innovation in 1923, and during the past year this has been much increased. Although much was heard at one time of a process for the extraction of insulin from pancreatic glands by water instead of alcohol, this process has not been adopted on a commercial scale, in spite of the apparent saving on the cost of alcohol that it would entail. The efficiency of the alcohol extraction has been so much increased by the British makers, Burroughs Wellcome and Co., Boots Pure Drug Co., Ltd., and the British Drug Houses, Ltd., in association with Allen and Hanburys, that at the present time the wastage of alcohol is so small that there would be no saving in adopting the otherwise less efficient method of aqueous extraction. The price of insulin has now been reduced to 2s. 8d. per 100 units, which compares very favourably indeed with the figure of 25s. barely two years ago. In addition, it is interesting to note that one manufacturer alone uses three tons of ox and sheep pancreas per week.

Synthetic Solvents and Resins

There has been considerable interest in the development of synthetic solvents. The chlorine derivatives of acetylene-trichlorethylene, tetrachlorethane, etc., have been made by the Castner-Kellner Alkali Co. for many years, and the demand for these has continued. Owing to the removal, to a certain extent, of the Government restrictions on the use of alcohol for industrial purposes, the manufacture of ethyl acetate has been undertaken on a large scale by W. J. Bush and Co., Ltd. This is expected to have considerable uses as an industrial solvent of low boiling point. Isopropyl alcohol is being made in considerable quantity by Howards and Sons, Ltd., of Ilford, and it is proving a valuable substitute for ethyl alcohol in the perfumery, confectionery and other trades, where the heavy duty on the commoner spirit is a great hindrance to low costs of production.

A most notable advance in the range of solvents manufactured in this country is the announcement of the production of cyclohexanol, cyclohexanone, and cyclohexanol acetate by Messrs. Howards. These products are made by the hydrogenation of crude phenol, and they form valuable solvents of high boiling point, suitable for use, it is claimed, in the varnish, cellulose, and rubber industries. Cyclohexanol is also valuable in that it may be incorporated in soaps, adding materially to their solvent properties.

Production of the synthetic resins formed by the condensation of phenols with aldehydes has continued during the year, and has shown signs of marked increase. The uses of these products appear to be unusually wide, and in addition to being used to make varnishes and lacquers, tiles and similar materials are now being made from synthetic resins. In the same connection we believe it is correct to state that the transparent synthetic glass formed by condensing formaldehyde with urea, which has been given much publicity recently on the Continent, was actually made independently in this country at an earlier date.

Photographic Chemicals

The manufacture of photographic developers, started here during the war, has shown distinct expansion during the past twelve months, in spite of the continued strong competition from the Continent. It is interesting to note that owing to the relative depreciation of the French exchange, and the stabilisation of German currency at a higher level, the competition is now entirely due to goods imported from France. Manufacturers state that the effect of the Safeguarding of Industries Act has been favourable in that it has enabled them to establish their business, and eventually to overcome the prejudice in favour of German products, but that the 33⅓ per cent. duty under Part I. is not really adequate protection against the competition of imported developers from countries having a heavily depreciated currency. So far from the Act having raised prices, it may be noted that metol developer made in this country by Johnson and Sons, Ltd., actually sells wholesale at a price about 25 per cent. lower than that of the German-made imported product in 1914. In this case of amidol the reduction in price is even more. These figures are really an immense tribute to the efficiency of British production, it being highly creditable that with the present high costs of labour and other items it is possible to sell the product at a lower cost than before the war.

Essential Oils and their Derivatives

The derivatives of essential oils, coumarin, isoeugenol, terpineol, vanillin, and so on, continue to be made in large quantities. One firm has made considerable extensions in its coumarin plant during the year, and is starting large-scale production of this substance which it only made in small amounts previously.

A new product of some importance is solid synthetic menthol, introduced by Howards and Sons. This is identical with the natural product, except that it is optically inactive instead of lævo-rotatory. As it is a racemic form, it has a lower melting-point (25°C. instead of 42°C.). Where this is no disadvantage, it may be substituted for the natural product, with a great saving in cost, the price of the new product being about half that of the natural one.

The production of laboratory chemicals and analytical reagents has been maintained, and in some cases manufacturers have increased the range of pure products available. It would be difficult to name compounds which now cannot be obtained from home sources.

Chemical Inventions of 1924

By Our Patents Correspondent

THE patents published in the course of a year probably furnish the most detailed and exact record of the research work which has been carried on and the discoveries which have been made, and as such are well worthy of the closest attention by those who wish to keep abreast of the latest developments. It is probably safe to say that there are few processes or apparatus now in use which could not be improved by the application of some of the published inventions to them, but unfortunately it happens only too often that inventions of the greatest merit pass into obscurity simply because the inventor has not been able to gain the manufacturer's interest. It has frequently occurred that some improvement devised after much research in the works laboratory has been found to be substantially identical with an invention of many years earlier, patented but never developed. A few of the inventions of the year, selected with a view to indicating the trend of developments, are briefly noted in this review.

Indiarubber

Some of the most interesting patents of the year relate to improvements in the manufacture of indiarubber, and in the use of accelerators of vulcanisation and retarders of oxidation. The vulcanisation of the latex without coagulation is receiving increased attention—*e.g.*, by adding ammonia or sufficient of an accelerator such as piperidine, or an alkaline vulcanising agent. Such vulcanised latex is particularly suitable for purposes such as the impregnation of fabrics, since it involves no solvents, no odour, and no inflammability, while the vulcanising temperature is below 100 C.° Several new vulcanisation accelerators have been patented, notably a condensation product of formaldehyde with ethylamine, benzylamine, diethylamine, or piperidine. In another patent, the injurious nature of paranitrosodimethylaniline, which is used as an accelerator in the Peachey process, is overcome by mixing it with β-naphthol.

Several patents are concerned with the evaporation and concentration of the rubber latex with a view to its employment as such, and coagulation is avoided by the addition of ammonia while evaporating by heating and passing heated air over the surface, with continual agitation and reduction of temperature as concentration increases. A concentration of 80 per cent. to 82 per cent. may thus be obtained. Another inventor has discovered a method of re-dispersing rubber, balata, or gutta percha, which have been coagulated, without at the same time depolymerising them. They are dissolved in benzol, xylol, or toluol, mixed with a saponifiable agent such as a liquid fatty acid, and the solution gradually mixed with aqueous ammonia. A dispersion of rubber in water may thus be obtained, which may be mixed with dispersed sulphur and used for impregnating materials. Another inventor sprays a colloidal suspension of rubber latex to dry it, and finds that the dry product remains plastic for a long period if kept in airtight receptacles.

The properties of rubber fillers have also been studied, and it has been found that if zinc oxide is made by oxidising an issuing stream of zinc vapour by a blast of relatively cool air, the zinc oxide is immediately cooled and is obtained in ultramicroscopic fineness, the average particle size being 0·15 microns instead of the usual 0·38–0·52 microns by the American process. If this zinc oxide is used as a filler for rubber an increased strength is obtained. In another case, a filler for rubber may consist of carbon black, colloidal clay, or a metallic hydroxide or silica gel which has been activated by heating to 400°–1,000° C. An increase in strength of the vulcanised rubber of 13 per cent. is obtained, together with an increased hardness, toughness, and resistance to abrasion, and a decreased time of vulcanisation.

As rubber preservatives, patents have been taken out for substances having a negative catalytic effect on the oxidation of sulphur, such as a mixture of glycerine and benzaldehyde, or a solution of phenylhydrazine and glucose, also for a condensation product of acetaldehyde and aniline.

Synthetic Ammonia and Ammonium Salts

There has been evidence of greater activity in synthetic ammonia processes, particularly in this country. Processes have been patented for purifying the nitrogen-hydrogen mixture by passing it through anhydrous liquid ammonia to remove water and carbon compounds, and for treating a mixture of nitrogen, hydrogen and carbon monoxide with steam and a catalyst to convert the carbon monoxide to carbon dioxide and hydrogen, the residue of carbon monoxide being absorbed in ammoniacal copper solution. In another case, ammonia is obtained by bringing air, clay, and carbon into contact with water vapour at 1,000° C.

An interesting process is that in which ammonium sulphite and sulphate are obtained directly from ammonia and sulphur dioxide, the ammonia being either synthetic or by-product. Ammonia and water vapour are mixed with sulphur dioxide and air, the concentration of sulphur dioxide being below 4·2 per cent. of the total volume. The ammonia is sufficient to render the mixture neutral or slightly alkaline, and the water is not sufficient to make the mixture wet after cooling, but sufficient to make the ammonium sulphite sensitive to rapid oxidation. The oxidation is effected by exposure to air, and the ammonium sulphate obtained is dry and neutral.

A process for oxidising ammonia vapour has been patented in which the ammonia mixed with air is passed over a heated mixture of lead oxide and an oxide of manganese, vanadium, molybdenum, chromium, tungsten, or uranium, with one or more alkaline earths. Other compounds of lead, manganese, calcium, barium, or strontium may be used—*e.g.*, calcium, barium or strontium ortho-plumbate, and an oxide of manganese.

Many new catalysts for synthesising ammonia have been patented, notably one in which ferrous or ferric chloride is treated with anhydrous liquid ammonia and dry potassium cyanide. The excess of ammonia is evaporated, and the residue heated out of contact with air. In the production of ammonium nitrate, a process has been patented in which oxides of nitrogen are partly absorbed in ammonium bicarbonate to obtain ammonium nitrite and nitrate, and partly converted into nitric acid which is then used to oxidise the ammonium nitrite. Details in the manufacture of ammonium sulphate as a by-product in gas manufacture continue to afford scope for improvement particularly in the production of a dry, neutral, and granular product.

Catalysts

That the physical form and structure of a catalyst has an important bearing on its efficiency is fully evident from the recent researches in this subject, and most of the inventions are concerned with the structure rather than with the actual composition of the material. Thus in one case considerably improved results are obtained by a special method of supporting the catalyst on a silica gel. The hydrogel obtained at an intermediate stage, and which contains 90 per cent. of water, is treated with dilute alkali and then immersed in ferric nitrate, washed and dried. Such a catalyst is much more active than those usually employed, and is capable of giving a 90 per cent. conversion of sulphur dioxide into trioxide, from a 7 per cent. mixture with air. The same method may be used for mounting an expensive catalyst such as platinum. The gel is impregnated with water and then treated with colloidal platinum which is thus prevented from penetrating far into the pores of the gel and is held on the surface so that a largely increased area of contact is obtained. A method has been patented for regenerating the nickel catalyst employed in the hydrogenation of oils, by removing the oil with a solvent, treating the catalyst with hypochlorous acid, and then reducing in hydrogen at 250°–350° C. An improved copper catalyst for hydrogenation or reduction is obtained by precipitating cupric hydroxide, separating it, adding alkali, and then passing hydrogen over it at 80–160° C.

Organic Reactions

Much work continues to be done in improving the manufacture and cheapening the cost of production of many of the commonly used organic products. Examples my be cited in the process for the chlorination of benzene, in which a mixture of benzene vapour, oxygen and hydrochloric acid gas is passed through an acid-proof tube containing a copper

chloride catalyst supported on pumice and heated to 400° C., yielding monochlorbenzene as the main product. Another inventor obtains formaldehyde by the catalytic oxidation of methyl alcohol vapour with a copper catalyst, and another obtains acetaldehyde by passing acetylene through sulphuric acid containing a catalyst such as mercurous sulphate.

An interesting new process relates to alkyl halides. In this case an olefine is mixed with hydrogen halide and passed over an oxide, hydroxide, halide, or oxyhalide of bismuth, antimony, or vanadium, to obtain the alkyl halide. Thus ethylene or propylene and hydrochloric acid gas passed over bismuth chloride yields ethyl chloride or propyl chloride. The process has an important application in the recovery of olefines from coal gas. In another process practically pure methane can be obtained by passing a mixture of petroleum ether or benzene and hydrogen over a nickel catalyst on pumice. Several patents have appeared relating to the manufacture of thymol from *p*-cymene and its catalytic hydrogenation to produce menthol. Other patents relate to the recovery of benzol from coal gas by passing it over metal surfaces cooled to −50° C. by the expansion of liquid carbon dioxide, the benzol being removed in the form of a snow; and to the recovery of ammonia and other constituents, particularly hydrogen sulphide in a pure form.

Many detailed improvements in the hydrogenation of oils and fats have been made. Thus, the difficulty of hydrogenating an oil which has been kept may be overcome if it is mixed while still fresh with a small quantity of a phenolic substance such as hydroquinone, guaiacol, or resorcinol; such additions can be removed after hardening.

Cracking Oils

A large number of inventions have been patented for cracking and otherwise treating shale and oils, most of these originating in the oil-producing countries such as America and Roumania. Those relating to improvements in plant show few outstanding departures in principle, but among new processes may be noted one in which shale is saturated with oil before distillation, resulting in the oil being liberated from the shale more readily. In another case heavy mineral oils, coal distillates, etc., are cracked by heating under high pressure with hydrogen. In such cases, further refining has usually been necessary to remove sulphur, but this may be avoided if the hydrogenation is effected in the presence of sodium, and an increased hydrogenation is also obtained. In another case the hydrocarbon vapour is passed over an adsorbent such as activated cocoanut shell charcoal, silica gel or ferric hydroxide gel heat heated to 400° C. or more. The resulting distillate is a light spirit which does not deposit polymerisation products.

Several inventions relate to the desulphurising of mineral oils. In one case this is effected by mixing with salt or caustic soda, and electrolysing, the action being accelerated by the addition of a catalyst of nickel or palladium. In another case sulphur is removed by vaporising and subjecting to sodium hypochlorite or calcium hydochlorite in alkaline solution. If the strength of the latter does not exceed 1·5 grams of available chlorine per litre, the sulphur is attacked but the hydrocarbons are not.

Gas Manufacture

Most of the inventions relating to gas manufacture have been concerned with the low temperature distillation of coal, with the additional object of obtaining a smokeless solid fuel as a residue, and with the complete gasification of coal by first distilling the coal by direct contact of hot gases, and then converting the coke residue into water gas. In such case the combination of a distillation retort and a water gas producer in a single structure one above the other, appears to be most in favour.

An interesting process for utilising small coal, refuse coke, coke dust, etc., for the production of water gas consists in placing the fuel on a plate of perforated fireclay and blowing air upwards through it at such a rate that it is kept in continuous agitation resembling boiling. This permits a free passage for the air through the fuel, and steam is then blown through in a similar manner to produce water gas. The ash is carried away with the gases and afterwards separated.

In the purification of coal gas from carbon disulphide, the activity of a nickel catalyst has been found to be greatly improved by the addition of oxide of thorium, chromium, beryllium, or aluminium, and in another invention for purifying gas from sulphuretted hydrogen, the gas, mixed with air or sulphur dioxide, is passed over activated silica gel. If only a small proportion of sulphuretted hydrogen is present, its removal is facilitated by adding ammonia or an amine. The gel may be regenerated by extracting the sulphur with carbon disulphide, and then treating with steam. Another inventor finds that the addition of finely divided heavy metal or oxide to coal before coking, or to the resulting coke, increases the combustibility of the coke. Iron or iron oxide is preferred, and may be added so that the coke contains about 1–3 per cent. of iron, or the coke may be treated with the corresponding amount of an iron salt. This treatment of coke also results in an increased efficiency when used in producer gas plant.

Dyes

The research which is continually being made in the dye industry is again shown by a considerable number of patents for new colours or new intermediates, mainly from German or Swiss sources. British inventors appear to have been concerned more with the practical details of the manufacture of well-known products or intermediates. Instances of the latter are seen in a process in which the number of stages in the manufacture of anthraquinone-1-chlor-2-carboxylic acid can be reduced, and in a process for separating the sulphonation products of β-naphthol, viz., 2-naphthol-3 : 6-disulphonic acid, and 2-naphthol-6 : 8-disulphonic acid, based on the solubilities of their dipotassium salts. Another process and apparatus of general interest for obtaining pure *p*-nitraniline include heating *p*-nitro-chlorbenzol and ammonia and spraying the mixture into a chamber to reduce the temperature and pressure, and crystallise the product. A very finely divided product of high purity is obtained, which can be directly employed in the manufacture of dyestuffs. Other patents relate to a special method for obtaining perylene from a dihydroxy compound of α-naphthyl, and to the production of dyestuffs from perylene, dibenzanthrone, etc.

Several inventors have turned their attention to the problem of dyeing by means of insoluble pigments in the form of colloidal suspensions. The material to be dyed is impregnated with a solution which yields the colour in the presence of a protective colloid. For instance, cotton can be impregnated with 1–3 per cent. of ferric chloride containing 1–3 per cent. of glycerine or sugar as the protective colloid. The fabric is then treated with ammonia, and then with very dilute hydrogen peroxide, and dried, the result being a very good red dyeing. In another method an inorganic pigment is treated in a colloid mill to obtain a colloidal suspension. Such a suspension will penetrate the fibres and may then be coagulated to fix the pigment. The same process may be used for dyeing cellulose acetate with amino anthraquinones in suspension or colloidal form, using as a protective colloid a condensation product of naphthalene and formaldehyde in sulphuric acid solution, or naphthalene sulpho-acids with formaldehyde; such dyes can be made in the form of pastes or powders which are used in the usual way.

The overcoming of the well-known lack of affinity of cellulose acetate for many of the usual dyes has again been the object of several patents, notably one in which the affinity is increased by treating with alkaline saponifying agents such as baryta water, in the presence of soluble aldehydes, or oxyaldehydes, and another in which some derivatives of anthraquinone, which are usually regarded as intermediates, are employed in an alkaline or hydro-sulphite vat.

Metallurgy

Metallurgical inventions during the past year have been mainly concerned with processes for the treatment of complex ores, and for the production of improved alloys for various purposes. In the former class may be mentioned a process for preparing complex ores containing silver for leaching, by heating them in a furnace and spraying with 1–5 per cent. of saltpetre; the silver is then readily soluble in hyposulphite lye. Another patent is for the separation of arsenic and tin in the presence of antimony, from mixtures obtained in the refining of lead. Another invention of interest is for obtaining aluminium and silicon from bauxite or clay containing iron. The material is reduced by means of metallic aluminium, sometimes with other reducing agents such as iron, silicon, ferrosilicon, silicon carbide or carbon, and the constituents other

than alumina form a regulus which is tapped off. The alumina may be electrolysed. Several processes have become available during the past year for the separation of zirconium and hafnium.

The use of iron ore containing much silicious and other non-ferric ingredients has always been difficult, and in one invention the problem is solved by leaching it with sulphuric acid and then converting the sulphates of iron and aluminium into oxides by heating. The sulphates of nickel and manganese remain as such and are separated by leaching, and the residue of iron, aluminium and phosphorus oxides is mixed with sodium carbonate and heated, yielding sodium aluminate and phosphate, which are then dissolved out from the ferric oxide. In a new process for obtaining vanadium, iron vanadate or vanadic acid is heated with ammonia or an ammonium salt to a red heat to obtain vanadium nitride, which is then subjected to alumino thermic reduction.

The froth-flotation method of concentrating ores continues to receive the attention of inventors, and several new frothing agents capable of separating metalliferous constituents have been patented. Thus xylene is found to be useful for separating galena from blende and pyrites, while toluene and solvent naphtha are somewhat less effective for the same purpose. New methods of separating copper from iron have also been patented.

Turning to the subject of the metals themselves, aluminium has been improved by adding the necessary amount of metallic calcium to combine with and remove the silicon; and steel of increased strength has been obtained by subjecting the molten steel to an explosive shock immediately before pouring. Some valuable researches into the subject of titanium steel have shown that previous failures to get satisfactory results have been due to the presence of carbon, which formed titanium carbide and prevented the alloying of the titanium and the iron. This can be avoided if the iron is refined to remove carbon as completely as possible, the titanium being then added in the form of a slag and reduced by adding the proper quantity of aluminium.

Acids

A few interesting improvements in the manufacture of sulphuric and other acids have been made. In one case the arsenic mud obtained by treating with sulphuretted hydrogen is precipitated in a form which is readily filtered by adding about 3 per cent. of benzene, petrol, paraffin, toluene, carbon disulphide, cresols, tar oils, chloroform or turpentine. Another inventor improves the manufacture of sulphuric acid by conducting the usual chamber reactions in a Feld or Theisen gas washer. The very high dispersion facilitates these reactions, and it is found that 1 lb. of sulphur can be oxidised in less than one-tenth of a cubic foot of space.

Some attention has been given to acid-proof containers, in one case by providing a lining of unvulcanised rubber, which is readily jointed, and in another case by making a shell of ebonite or vulcanite, placing it in a brickwork casing, and filling in the intervening space by pouring in concrete.

General

Among miscellaneous inventions, several have been noted relating to the recent method of distilling oils, tars and solid materials, etc., by contact with molten metal, and also several mainly of Dutch origin relating to activated carbon and its manufacture. Other activated materials patented include calcium carbonate, sulphite, sulphate, oxalate, tartrate and phosphate, and means have been devised for supporting the latter more expensive products upon the cheaper calcium carbonate. The study of the use of other adsorbents in the form of gels to promote chemical reactions is increasing, and improved methods of making gels of oxides of iron, tin, aluminium, tungsten and titanium have been patented.

Increasing use is being made of materials in colloidal form. Thus arsenic trisulphide, which is usually regarded as non-poisonous, may be obtained as a poisonous preparation suitable for agricultural use by precipitating it as a colloidal suspension by adding a protective colloid to a solution of arsenious oxide and then treating with sulphuretted hydrogen.

The application of scientific principles to the paint and colour industry has been further extended in the production of new pigments, and in the improvement of the manufacture of well-known pigments, such as titanium oxide, white lead, and lithopone. In the case of lithopone a promising invention has been patented by which the lithopone is treated before calcination to produce a protective coating on the particles by quenching in barium sulphide solution instead of water. The zinc sulphide is then not oxidised by exposure to air. Another inventor obtains barium sulphide very readily by mixing finely ground barium sulphate with pulverised coal and blowing it into a combustion chamber.

Much work continues to be done in the investigation of the properties of the colloidal forms of various substances, notably sulphur, various organic materials, and some of the metals. In the latter case an original method of obtaining a colloidal solution of silver has been noted in which an electric arc is formed between silver electrodes in a very high frequency circuit. A colloidal dispersion of silver is obtained which is a very powerful bactericide.

Dyestuffs Industry in 1924

By L. B. Holliday

THE British dyestuffs industry during the year 1924 has been like all others, suffering from the abnormally bad trade, and consequently there has been a good deal of idle plant in the country.

This has affected the progress of the industry as it has shaken the confidence of most of the manufacturers, the consequence being that there has not been money to spare for a large amount of practical research work and additions of novelties in plant.

The numbers of dyewares manufactured in the country have largely increased during the year 1924, the variety of colours that are now produced in the country being very large indeed, and consequently the necessity for buying foreign dyewares has become very greatly minimised.

Great progress has been made in all lines of colours where quantities in ordinary times are likely to be consumed, and much work has been done and good progress made in many of the most complicated dyestuffs.

With regard to the important manufacture of the necessary early and intermediate products for the manufacture of dyestuffs, these have made very considerable progress and it is not now necessary to import into the country any of the most used and most important of these commodities.

There are a very large number of dyestuff manufacturers in the country to-day, and the large Government subsidised concern has to meet a very keen and energetic competition in practically every line that it manufactures. Nothing has done the industry more good than the healthy competition that has existed in it during the year under review and this competition is being made the most of by all consumers.

It is a great pity that trade in general has been so bad during the last two or three years. There is no doubt that this serious handicap has done as much as anything in holding back progress in the dyestuffs industry, and if trade becomes better and confidence is once again restored into the industry the speed of progression will be enormously increased, more research work will be carried out and results even better than those obtained during the year 1924 will be shown.

With regard to the cost of manufacture, costs have come down enormously and prices to-day in Great Britain are extremely low, and it will in course of time be found that the cheapest country to manufacture aniline dyes in is Great Britain. The rates of exchange are largely responsible for the lack of foreign trade in the dyestuffs industry and not cost of production. The cost of production can still be greatly reduced by sensible co-operation between the many manufacturers in the country, as there is still no organisation existing that can adequately deal with the expensive system that arises where there is a large amount of duplication.

On the whole, 1924 can be put down as being a good year as far as achievements are concerned, but a bad year as far as profits are concerned and as far as the trade having received adequate remuneration for its efforts.

Chemical Engineering During 1924

From Our Own Correspondent

THE close of every calendar year is useful as it is the customary time for a retrospect of the changes that have taken place during the year, so that an estimate can be made—in so far as such is possible so near to the events examined—of the direction in which alteration is proceeding, whether towards sound progress or into disastrous retrogression. If such annual examination be of advantage when applied to long-existing varieties of human endeavour, it is much more so in the case of something relatively novel in the life of the nation, as are the science and practice of chemical engineering. It is astonishing to find, even at this date, and despite the costly and bitter lessons of war-time experience, many men of position and authority, leading otherwise blameless lives, declaiming against "that peculiar hybrid, the chemical engineer." Nevertheless, the chemical engineer is making considerable headway towards the fullest recognition in the life of the nation, and the year now ending is marked by several noteworthy events which illustrate the progress that has been made.

Two Notable Conferences

The first of these—and one of the outstanding scientific events of 1924—was the holding of the World Power Conference at Wembley Exhibition, under the auspices of the British Electrical and Allied Manufacturers' Association. This last mentioned body deserves the highest possible praise for translating the idea of such a conference into successful practical shape. The conference dealt, of course, primarily with electrical power *per se*, but since a great deal of electrical energy results from transformation of chemical energy, and bearing in mind also that chemical energy is used very largely directly, i.e., without preliminary change into electrical energy, an important section of the Conference dealt with other than electrical aspects of power and its uses. The Chemical Engineering Group of the Society of Chemical Industry, in collaboration with the National Gas Council, were entrusted with the organisation of the non-electrical side of the Conference on Power, and the meetings arranged under the joint auspices of these two bodies were extremely interesting and successful. A comprehensive report of all the proceedings of the conference is in process of being issued, and will form a valuable reference library for engineers of all kinds for many years to come. It is to be hoped that similar conferences will be arranged in the future, from time to time, so as to ensure a useful exchange of national and international ideas, experience, and information upon a subject of vital importance to the human race.

The second important occurrence (in England) during the present year was the formal opening, by Prince Arthur of Connaught, of the Ramsay Memorial Laboratories of Chemical Engineering at University College, London. The occasion was marked by the presence of men distinguished in many branches of science and industry, and it is sincerely to be hoped that the blessings so gracefully bestowed upon the enterprise by the Prince will be abundantly realised in the future. It is interesting to note that in the speeches made during the opening ceremony, opinions were expressed and anticipations uttered with reference to chemical engineering matters, for which the founders of that energetic body, the Chemical Engineering Group, were oratorically and polemically crucified less than ten years ago.

It must be freely confessed that the space and equipment available for chemical engineering instruction in the Ramsay Laboratories are extremely meagre and do indifferent honour to the memory of the great scientist whose name they bear. A beginning, however, must be made somewhere, and it is distressing to think that lack of adequate financial backing has prevented a more auspicious start. It is devoutly to be hoped that progress to larger premises, apparatus, and achievement will not be hindered from the same cause. The Ramsay laboratory is fortunate in having at its head in Professor Williams, a young, energetic, and yet experienced man, and, given reasonable scope, he should quickly make a name for the organisation under his direction.

Institution of Chemical Engineers

Still confining attention to what may be termed the "academic" side of chemical engineering, it is pleasing to recall the work accomplished during the year by the Institution of Chemical Engineers and the Chemical Engineering Group of the Society of Chemical Industry. The preparation by the former body, in consultation with leaders of education and industry throughout the country, of a most interesting memorandum on "The Training of a Chemical Engineer" is a work of fundamental importance and reflects the greatest credit upon Colonel Sir Frederick Nathan, Chairman of the Institution's Education Committee, under the auspices of which the Memorandum was issued. The work is not yet finally completed, but this is now only a matter of a very short time, and the completed work, which presumably the Institution will revise from time to time as circumstances dictate, should prove a most valuable help to educational bodies and institutions throughout the country who are desirous of assisting along present paths of progress.

The Institution has been fortunate, not only in initiating the enterprise just referred to, but also in the issue of certain very important papers, among which the monumental one by Mr. Finlayson on "Industrial Oxygen" takes pride of place. It is refreshing to peruse this paper and to see how Mr. Finlayson keeps continually before him the all-important criterion of chemical engineering success, "Will it pay?" The pure chemist is not interested in such a query; it is the chemical engineer's first interest. The other papers read are both of interest and value, but none is of so comprehensive and valuable a character as the "Oxygen" paper first mentioned. The Institution has in hand a useful programme for the 1924-25 session, and one matter—the question of the heat units employed in preparing thermal balance sheets—arising out of a recent paper dealing with certain aspects of gasworks activity, should give the Institution a valuable opportunity to unify existing divergence and diversity of practice. It is pertinent to mention here, whilst dealing with the work of the Institution of Chemical Engineers, that a joint meeting of the American and the British Institutions is in prospect for 1925 in England during July—surely the first time such an international gathering has been held in the history of civilisation and industrial progress!

The Group's Activities

The Chemical Engineering Group of the Society of Chemical Industry has kept up, during 1924, its former well-earned reputation for enterprise and useful accomplishment. The papers read before its meetings comprise one on "Heat Transmission," by Mr. B. Heastie, which will well repay the most careful study. Later papers read before the Group include a most valuable symposium on "Water Treatment" jointly held with the Institution of Mechanical Engineers, and one on "Centrifugal Dryers" by Mr. E. A. Alliott.

The most important meeting held by the Group during 1924 was for consideration of two papers on adsorbents:—"Activated Carbon" and "Silica Gel." These aroused an enormous amount of interest, typifying the increasing importance substances of this kind are assuming in the most varied industrial operations. The importance of "surface" considerations in chemical manufacture is very often lost sight of, and for no reason that is easily discoverable. The interaction of different kinds of material substances must of necessity be a surface effect throughout the range of their independent and individual existence. The statement seems obvious, yet it is often forgotten by designers of plant for all kinds of industrial work.

An interesting innovation in the kind of paper read before the Group was made a few weeks ago when the subject of "Chemical Works Costs" was open for discussion. Those who were privileged to attend the meeting were doubtless surprised at the variety of opinions held regarding such costing by people competent to deal with these matters, and it seems obvious that a renewal of the discussion at no distant date would be to the advantage of all concerned. In this connection it is perhaps pertinent to suggest that costing systems should regard the filling up of "forms" as means

to an end, and not the end itself. Some of the speakers at the meeting referred to were, to some extent, of the latter opinion.

Smoke Abatement

Mention may be made, whilst discussions and conferences are being considered, of the gathering of the Smoke Abatement League and Exhibition in Manchester—undoubtedly the most appropriate place on this side the hereafter for such meetings to be held. Both Conference and Exhibition were a very great success, and it is not too much to expect that great good will ultimately accrue from the effort expended. Such a Conference could not, of course, take place without the subject of "Low Temperature Treatment of Coal, etc.," being considered, and some valuable papers on this topic were contributed. The subject is growing in importance, and it is high time some authoritative and representative body was formed not merely to guide public opinion and shape politicians' perorations, but also to co-ordinate the huge variety of endeavour being applied to the problems involved. The Institution of Chemical Engineers, in association with other technical bodies, might very well undertake this work and thus ensure, at any rate, its proper initiation.

Steady Advance in Ideas

Turning now to the industrial side of Chemical Engineering progress, the year's record is one of steady advance in ideas, if not in their commercial application. Trade generally in this country has not been much better than during 1923, and the political situation, for the greater part of 1924, was such as to discourage capitalists from embarking upon any fresh commitments in support of manufacturing development. The situation at the present time in this connection is much more hopeful, and all portents point to better business and more rapid progress during the next few years.

In the realm of constructional materials, a number of important researches have been made during the year upon the corrosion under different conditions of use in manufacture of the commoner substances employed in building plant. The results obtained have led, in the case of fibrous materials such as wood, paper and so on, to the introduction of new methods of "reinforcement" of the fibres, which, provided the cost of treatment is not too great, should prove of great value. Further progress is also to be recorded in the manufacture and use of "Proderite"—a hydrochloric-acid-resisting material introduced into chemical manufacture on the Continent. Moreover, the experience being gained of the properties of the commoner constructional materials under extraordinary conditions of use—high temperatures and pressures or great mechanical stress—is being turned to good account in plant design.

Of Fuel Treatment processes, much progress has been made along the many diverse ways now being pursued by inventors dealing with the Low Temperature Treatment of bituminous materials, without any outstanding achievement worthy of special note. More is being done in this direction on the Continent than in England, and some of the projects put forward seem of doubtful ultimate success. The necessity of co-ordinating as far as possible all the various activities being undertaken in this direction has already been mentioned, and may soon assume national if not international importance. Further work has been done on the utilisation of peat and of lignite, and investigations on the hydrogenation of various fuels, as in the Bergius process, are making satisfactory progress. The endless subject of Gasification of Fuels continues to be productive of useful empirical inquiry and result, and has led to considerable development during the past year in the use of selective absorbents such as "Activated Carbon" and "Silica Gel." Fuel Economy in steam-raising plant claims the attention of many workers, especially those interested in the production of electricity, where already very gratifying figures for the ratio of coal burnt to units of electricity produced have been achieved. The tendency for steam raising units to be designed to work at higher temperatures and pressures than formerly continues to extend, and a new device, an "internal combustion" boiler, invented by Otto Brünnler, has been recently described. Progress in this direction almost always involves advances in evaporator practice, and increasing use of "Heat pump" evaporators, in various forms, is noteworthy.

Separating machinery of the type of the filter press shows little advance, apart from the ingenious "Stream-line" filter, which has now been used for filtering and cleaning certain industrial gases. Centrifugal machinery finds new applications, e.g., in the treatment of water-gas tar, and much more use than formerly has been made during the year of high-speed small diameter centrifuges for very difficult separations or clarifications. Comminuting and Grinding Machinery of the type of the Plauson Mill has been devised in new forms, and will doubtless find limited application, the great drawback to apparatus of this kind being the cost of treatment per unit of material handled. Progress of minor importance is to be noted in the categories of crystallisation, solution, drying and electrolytic plant.

Summarising what has been set out above, it may be said that, whilst nothing spectacular has been achieved in the domain of Chemical Engineering during 1924, the steady progress noted is movement in the right direction. The future is bright with promise to the extent that political, social and industrial conditions remain undisturbed, and in so far as manufacturers generally increasingly realise that far greater economies in the cost of production are possible outside the boiler-house than within its grimy portals.

A New Protective Lead Paint

ACCORDING to an Austrian chemist, Mr. Rudolf Ditmar, there is now being marketed in Europe, under the name of "Subox," a protective coating material or paint, which consists of a suspension of colloidal lead, which is thus described in *Chemical and Metallurgical Engineering*. Applied to iron, metals, wood, cardboard, cement, etc., it is claimed that a firmly adhering film of metallic lead is obtained on the coated material after the suspension agent has become dry. This adhesive quality seems to be characteristic of colloidal gels. This phenomenon has also been observed with colloidal sulphur in suspension. If sulikoll, which is a suspension of colloidal sulphur for use as insecticide, is sprayed on leaves, the finely divided sulphur also adheres very firmly on its foundation after it becomes dry and cannot be washed off by rain. Spraying with the usual sulphur preparations does not produce the same results as the sulphur does not adhere and is washed off.

"Subox" is the invention of a Swiss engineer who worked out an electrical process which brings lead into colloidal form. This electrically atomised lead is rubbed with linseed oil in a manner entirely analogous to that of the red lead colours, and has the appearance of a grey oil colour. Prior to its use it must be well stirred and applied in undiluted condition. The first coat is to be applied very sparingly and should possess no oil lustre after it dries. Only the second coat gives a brilliant surface. Because of its grey colour it does not require a finish coat. As against red lead, "Subox" has a higher covering capacity which brings the cost in line with competing materials.

Experiments were carried out on a piece of black plate that had been built into a roof without any protection for years, and had become rusty in many places owing to the absence of any rust protection. Five years ago this roof was coated with "Subox," and when taken off four years later it showed no traces of penetrating rust on the coated or leaded surface, in spite of a thorough examination; rather was the oxidising process entirely suspended, due to the iron sheet metal being coated with the air-tight layer of lead.

Germany's Steel Industry

ONLY six of the fifteen blast furnaces in Upper Silesia were in operation at the end of October, says a Berlin correspondent of the *Board of Trade Journal*, and foreign sales were poor. A slight recovery was recorded in the finished iron market, while the revival in zinc was maintained, and inland sales of zinc plates for building purposes were brisk. In Siegerland iron and the small iron and tool industries in the Mark district little improvement was recorded. An improvement was noted in the Solingen small iron and steel ware industry, although foreign sales were difficult. On the metal market prices for copper, zinc, lead, and tin recovered strongly. In the electro-technical industry the improvement in sales continued. The petroleum industry continued to make satisfactory progress, and sales of fertilisers increased.

Chemical and Allied Societies

Notes on Their Work During 1924

The Association of British Chemical Manufacturers

It is probably superfluous to remind readers of THE CHEMICAL AGE of the part played by the Association in organising at the British Empire Exhibition what is believed to be the finest chemical exhibit which has ever been seen. We think it has achieved the object which the Council had before it in showing to the world the present position of British Chemical Industry and the progress which is being made in the science of chemistry, which is fundamental to its stability. In the latter work the Association secured the valuable co-operation of the learned Societies, Universities and Colleges throughout the country, without whose assistance the Scientific Section would have been almost impossible. Mention must also be made of the publications issued in connection with the Chemical Section, including *Chemistry in the XXth Century*, a work which achieved instantaneous success, and the eight popular pamphlets on chemical subjects, which made an extraordinarily wide appeal to the general public, to whom many thousands of copies were sold. It is confidently believed that the status of British Chemical Industry has been greatly enhanced in the eyes of the world by the Exhibition at Wembley. Publicity has also been obtained by means of the two films which the Association has had prepared, illustrating the manufacture and uses of heavy chemicals and coal tar products. These films have been exhibited in over 100 cinemas throughout the country, as well as privately by scientific societies and individual firms.

With regard to the Dyestuffs Industry, the policy of the Council has been directed to the safeguarding of the interests of all the dye makers in the country and to making the industry more efficient. The proposed agreement between the British Dyestuffs Corporation and the Interessen Gemeinschaft was considered to be inimical to these interests and was therefore opposed. The work of the Dyestuffs Licensing Committee and of the Dyestuffs Development Committee has proceeded continuously throughout the year. Incidentally, the Council has extended its sympathy to the establishment of a British Textile School in China.

The Safeguarding of Industries Act has worked smoothly during the year, and under Part I of the Act only one case has been heard by the referee during the past twelve months. In this case the formaldehyde sulphoxylates of sodium and zinc were held to be rightly included in the schedule to the Act on the ground that they were synthetic organic chemicals. The operation of Part II of the Act has ceased during the year.

The Council has devoted considerable attention to methods of chemical analysis as used in the industry with a view to their standardisation where such a course has seemed advantageous. A standard method of determining the tar acids in cresylic creosote has been devised and has been adopted as a British Standard by the British Engineering Standards Association. A standard method of testing pitch has also been drawn up and adopted by the tar distillers, and efforts are being made to secure its adoption abroad amongst buyers of British pitch. The Association is also co-operating in an inquiry into the methods of analysing essential oils.

An important feature of the work of the Association has been, as usual, connected with Parliamentary matters. The Council has been continually in touch with the Government Departments concerned with legislation affecting chemical industry both as advisers and critics. Among matters which are being very closely watched is the proposed Consolidated Factories Bill, which is of vital importance to the industry. A Departmental Committee has been set up to consider the question of the Rating of Machinery and the Council has suggested that the basis for valuation of industry should be the structure of works plus the first motive power. Evidence was given by the Association in connection with the inquiry into the use of preservatives and colouring matters in foods. The Council has also considered very thoroughly the evidence to be given on behalf of the industry before the Government Committee on Industry and Trade. Advice has also been given with regard to the census of production which is to be made in respect of the past year. It is to be regretted that the usefulness of the census is so restricted by the limitations of the Census of Production Act, 1906.

The unsatisfactory features of the Forms of Contracts used by official and public bodies have also been considered and representations made to the Federation of British Industries on the subject. The Forms of Contract with Government Departments have since been amended. Attention has also been given to the question of unfair competition, which has become an international one and is under the consideration of the Economic Committee of the League of Nations.

The question of International Patent Law is an important one and the Association has become affiliated with the Trade Marks, Patents and Designs Federation, a central organisation designed to watch the interests of British manufacturers.

Mention might also be made of the Association's connection with the establishment of the Department of Chemical Engineering at University College, and the formation of the Institution of Chemical Engineers.

Transport.—The Council has been actively engaged with the important questions of principle that have been dealt with by the Railway Rates Tribunal during the past year. The most important of these is the question of the Standard Revenue of the Railway Companies as provided for by Section 58 of the Railways Act, 1921. Eleven days were occupied by the Tribunal in determining the standard nett revenue for the year 1913 and the additions to be made thereto, and decisions were made in favour of the traders which have the effect of considerably reducing the claims of the Railway Companies. The railways have lodged an appeal against certain of the decisions, but it is hoped the Court of Appeal will uphold the Rates Tribunal. The new proposals of the railways for the addressing of goods both by passenger and goods trains have been dealt with in conjunction with the Traders Co-Ordinating Committee and an amicable settlement arrived at.

The Association is at present considering the proposed regulations of the railways for the labelling of dangerous, corrosive and poisonous chemicals with distinctive coloured labels, and a meeting between the Association and the railways will shortly be held, when no doubt an arrangement will be arrived at which will meet with the approval of all concerned. There is a marked tendency on the part of the railways to confer with the Association before putting new regulations into operation. This is very satisfactory, inasmuch as it enables the manufacturers to place their views before the companies and results in the adoption of agreed regulations.

During the coming year the most important matter to be dealt with is the fixation by the Railway Rates Tribunal of the new standard charges for merchandise and passenger train traffic.

As in past years, the Association has co-operated in the work of the various Associations affiliated with it. In connection with the British Chemical Plant Manufacturers' Association a Joint Research Committee has been engaged in an investigation of various chromium alloys and their use in chemical plant. A standard specification for covers for steam-jacketed pans has also been in active preparation. G. J. A.

The British Association of Chemists

THE Association is steadily advancing towards the attainment of its original aims; its membership has increased during the current year, and resignations appear in most cases to have been due to the serious trade depression. Unfortunately one of the most rapidly developing of its activities has been the Unemployment Benefit Fund, which, despite the heavy calls made upon it, is in a most satisfactory condition. Such have been the depressed conditions of the chemical industries in the last four months that double the normal sum has been paid out in benefit. The Chairman of the Unemployment Benefit Committee has, however, lately reported that the fund is well able to sustain the additional pressure imposed upon it. In relieving chemists who, without it, might suffer serious financial embarrassment, the fund has performed within the profession unique and extensive work; and it has more than justified the hopes attending its first formation.

Members of the Association are beginning to realise and, in consequence, to make use of the Legal Aid Department.

During the current year in all cases where recourse to it has been had, and where our legal advisers have recommended action, a satisfactory settlement has been arrived at. But the Association has felt that this will not suffice. It is aware of the unsatisfactory conditions under which some chemists are employed though there may be in them no formal infringement of law, and these conditions the Association feels it a duty to investigate. It has been able to obtain for its members conditions which are, on the whole, satisfactory, though in many cases capable of improvement, but it can obviously give no undertaking in respect of those who still remain outside its ranks. Since, however, the Association regards itself as representative of the aims of the whole profession, it regards an injury done to any individual chemist—a member of the Association or no—as an injury done to the whole professional body. In this connection, therefore, it is proposed considerably to extend the scope of its protective activities.

In regard to education, the appropriate committee is at present being reorganised. The Association has never claimed to be, in any academic sense, a qualifying body, but it very definitely maintains that membership implies a minimum qualification, without which no person ought to be permitted to practise. Registration of those practising chemistry is among the principal aims of the Association; so that it claims a right to a voice in the educational facilities at the disposal of those seeking to enter the profession.

The Council and the head office are gratified to note that increasing use is being made of the facilities by which members can obtain income tax relief in respect of damaged clothing. It is not inappropriate again to point out that this relief in most if not in all cases covers the cost of subscription, and that if a large number appeal for relief a precedent will be easily and quickly established.

All chemists employed by co-operative societies are invited to approach the Association with a view to membership. These bodies have recently ruled that all their employees must be members of a trades union, and the Association, while remaining uncommitted, and, indeed, strongly deprecating some principles of the modern trades union, is—uniquely amongst chemical organisation—of necessity registered as such. The Association has, as in the past, taken an active interest in all industrial questions, but it has never stood, and will never stand, committed to the maintenance of a set of principles proper to any faction whether of employers or employed. As in the case of the Whitley Councils the Association unequivocally refuses to concern itself with any court of arbitration that will not recognise the representatives of the chemical profession as "third parties."

The Association is now recognised as the mouthpiece of an important section of the chemical profession. In the "Dyestuffs Agreement Controversy" it was the first chemical organisation whose deputation has been personally received by a President of the Board of Trade, and it is not too much to say that the Association's protest turned aside a serious blow aimed at the Dyestuffs Industry and, through it, at the chemists of this country.

An extensive campaign of national propaganda is now being organised in order to bring before all chemists the unique advantages which membership of the Association can confer, and to impress upon all whom it may concern the value of the pioneer work which the Association is doing, and has done in the cause of industry and on behalf of chemical science. In order effectively to cope with the ever-widening scope of the Association's activities a large increase in membership is necessary, and the Council confidently expects that, despite the exceptional difficulties that trade depression has brought about, the necessary increase will be effected.

The question of the registration of all chemical practitioners has lately been receiving the earnest consideration of the Council. It becomes every day increasingly evident that the closing of the profession is vitally necessary, as much in the interest of the public as in that of the chemists themselves. But, owing to circumstances over which the Association has not, as yet, complete control, advance in this direction has necessarily been slow. The time, however, is not far distant when some active measures will be taken in this connection. H. T. F. R.

British Engineering Standards Association

Among the activities of the British Engineering Standards Association during the year under review may be mentioned a Specification for Chemical Lead for acid chambers and similar uses, which will be accompanied by a standard method of analysis prepared by chemists who have specialised in this direction. It will be published very shortly, and should be of very real value to the industry. A committee of the Association has in preparation a similar paper dealing with Regulus Metal.

A British Standard Specification for Filter Press Plates and Frames has been prepared and is now ready for publication, and a British Standard Specification for a cover for the Steam Jacketed Pans dealt with in B.S.S. No. 186, is under consideration.

Another committee of the Association is engaged upon the revision of B.S. Specification No. 188. "Determination of Viscosity in Absolute Units," which was published only in 1923. Evidently the Association loses no time in undertaking the revision of its specifications when there appears to be good reason for doing so.

Of interest also are B.S. Specification No. 209, "Fuels for Heavy Oil Engines," and No. 210, "Classification of Pure Mineral Lubricating Oils."

British Sulphate of Ammonia Federation, Ltd.

The outstanding feature of the year has been an increase of nearly 8 per cent. in the world's production of sulphate of ammonia, bringing the total output up to about 2,473,000 tons and thus securing for sulphate of ammonia the premier position among nitrogenous fertilisers, so long held by nitrate of soda. Moderate prices declared by the Federation and by the most important groups of producers on the Continent, have made it possible, in the short space of one year, to introduce this large additional quantity of sulphate, amounting to over 190,000 tons, into the world's consuming markets without a preliminary cataclysm in prices. If the price for the year under review is compared with the average price of the years 1921–22 and 1922–23, it will be seen that the 8 per cent. increase in consumption has been secured at a cost of a reduction of 10 per cent. in the price.

While events of the year point to great possibilities in the matter of foreign consumption of sulphate, notably by Japan, a further small increase in the home consumption can be recorded. The total production of sulphate, as such, for the year ending May, 1924, may be estimated at about 401,000 tons. The total quantity used in Great Britain and Ireland for all purposes may be taken as 143,200 tons, and the Customs returns show that 259,680 tons were exported, but this figure includes 1,330 tons delivered to the Channel Islands, which is included under home use.

Propaganda has been vigorously continued in Spain, Canary Islands, Portugal and Italy. The general manager has visited India and Palestine and laid the foundations of future publicity, and propaganda work is also receiving attention in China under the supervision of Brunner, Mond and Co. (China), Ltd.

The Federation now numbers over 400 members, whose annual production represents about 90 per cent. of the total annual output of Great Britain. Practically all the Indian producers have joined the Federation.

Mr. D. Milne Watson was re-elected chairman at the fourth annual general meeting in November.

The Chemical Society

The Chemical Society was founded in 1841, and received its Royal Charter in 1848. The object of the Society, as laid down in the charter, is the general advancement of chemical science by the discussion and publication of new discoveries, and the interchange of valuable information respecting them. Under the terms of the supplemental charter granted in 1920, the membership consists of fellows and honorary fellows. Fellowship is open to members of either sex. Every candidate for election as a fellow must be proposed according to a form of recommendation subscribed by not less than three fellows of the Society to whom he is personally known. In the case of a candidate resident abroad who is unable to obtain three signatures, the council has the power to accept a certificate signed by one fellow of the Society. The annual subscription is £3. The admission fee (£3) has been remitted for a time. The total membership now exceeds 4,000.

The affairs of the Society are conducted by a council, elected by Fellows from their own body, consisting of the president,

not more than twelve vice-presidents, the treasurer, secretaries, and eighteen ordinary members of council.

Ordinary scientific meetings are held, as a rule, twice a month from October to June. At the meetings, papers are read and discussed, and lectures delivered by men eminent in chemistry and the allied sciences. The Society publishes monthly the Journal, consisting of original memoirs communicated to the Society, and Abstracts of papers bearing on chemistry appearing in recent British and foreign journals. The annual reports dealing with the recent progress of chemistry in its various aspects are published in March of each year. The Society possesses a library of some 28,000 volumes, which may be borrowed under certain regulations.

The present officers of the Society are: President, W. P. Wynne, D.Sc., F.R.S.; treasurer, Jocelyn F. Thorpe, C.B.E., D.Sc., F.R.S.; secretaries, T. Slater Price, O.B.E., D.Sc., F.R.S., and C. S. Gibson, O.B.E., M.A.; foreign secretary, A. W. Crossley, C.M.G., C.B.E., F.R.S.; assistant secretary, S. E. Carr, F.C.I.S.; librarian, F. W. Clifford.

The Colour Users' Association

THE Colour Users' Association, Cromwell Buildings, Blackfriars Street, Manchester, is an association formed in 1919 to take over, continue and extend the work commenced by the Colour Users' Committee on October 8, 1915. The principal objects are:

(1) To watch over, protect, and promote the general interests of all users of dyes.

(2) To assist in the promotion and development of the dye-making industry in this country.

(3) To act as an official body for the representation of all concerned in the use of dyes in all negotiations with the Government or any department thereof, or in negotiations which concern the trade as a whole.

(4) To afford facilities for consultation and co-operation and the interchange of views between all concerned in the use and manufacture of dyes.

An idea of the range of the Association's activities may be gathered from the report for the past year, which touches on such headings as the B.D.C. and the I.G.; Reparation Dyestuffs; Surcharges on Colour Samples; German Production, etc., and special committees include an advisory licensing committee and a dyestuffs development committee. An important result of the work of this latter committee is the production of a list of colours made in Great Britain, together with their foreign equivalents. Copies of the "Vade Mecum" for 1923–24 are still available.

The membership stands at 223, and the present officers are: President, Mr. Henry Allen; Chairman, Mr. H. Sutcliffe Smith; Hon. Treasurer, Mr. J. R. Denison; Hon. Technical Advisor, Mr. G. E. Holden, M.Sc., F.I.C.; Secretary, Mr. Ellis Green, F.C.A.

The Faraday Society

THE Society has had a busy year having held four general discussions in addition to four ordinary meetings.

On April 28 a general discussion took place on "Fluxes and Slags in Metal Melting and Working," held jointly with the Institute of Metals with the co-operation of the British Non-Ferrous Metals Research Association and the Institute of British Foundrymen. An opening survey was given by Professor C. H. Desch and the papers which followed divided themselves into two groups, one dealing with melting and smelting and the other with slag inclusions, welding and soldering. The discussion, which was chiefly confined to non-ferrous metals, showed that while much empirical information was available, there were many gaps in our knowledge of the scientific principles underlying the processes described.

A general discussion was held on June 11, at the British Empire Exhibition, Wembley, jointly with the Textile Institute, on "Physical and Physico-Chemical Problems relating to Textile Fibres." The opening paper was given by Dr. W. Lawrence Balls, and contributions were made from practically every laboratory in the country engaged on textile research. The discussion was continued at Nottingham on October 30 jointly with the Nottingham Section of the Society of Chemical Industry.

The Society broke new grounds on October 22 in attacking geological problems. A general discussion was held jointly with the Geological Society and the Mineralogical Society on the "Physical Chemistry of Igneous Rock Formation." The introductory address was given by Dr. J. G. Flett, Director of the Geological Survey. A feature of the discussion was a statement by Dr. J. W. Evans and others, of the geological problems awaiting experimental investigation in the solution of which the aid of physicists and chemists is sought.

On December 9 the Society once again devoted an evening to soil science, a group of papers on "Base Exchange in Soils" having been presented and discussed.

Among the miscellaneous contributions mention should be made of a report on the great explosion at Oppau, presented on April 14 by Sir Robert Robertson, Chief Government Chemist, and Dr. G. Rotter, of the Research Department, Woolwich.

At the annual meeting held on July 7 Professor F. G. Donnan was elected President, in succession to Sir Robert Robertson, whose term of office expired on October 1.

The programme for 1925 includes a general discussion on the "Physical Chemistry of Steel-making Processes," which will be held jointly with the Iron and Steel Institute, probably on June 8.

F.S.S.

The Institute of Chemistry

THE roll of the Institute of Chemistry has steadily increased during the past few years. It appears likely that the Report of Council, to be submitted to the annual general meeting on March 2 next, will show that the rate of progress has been fairly well maintained; about 300 new Fellows and Associates have been elected, and the number of members at that date is likely to approximate 4,700. With this indication of the growth of the profession some concern may be felt on account of the difficulty to find employment for a temporary surplus of chemists; but the records of the Appointments Register of the Institute show that a steady absorption has taken place, and the actual number of chemists disengaged has not increased since the close of 1921. The Institute is glad, however, to hear of any openings and will readily assist employers to secure the services of well trained chemists in industry or private laboratories.

Local sections, which afford facilities for professional and social intercourse to the members in their respective districts, have continued active, both in their own immediate proceedings, which have frequently been shared by the local sections of the Society of Chemical Industry and other bodies, and in sending their views and suggestions to the Council. The meetings have been generally well attended throughout the country and many excellent addresses and papers on matters of interest to chemists have been submitted. Of these, Mr. Chaston Chapman's talk to students on "Some Factors which make for success in Chemical Practice," Mr. Griffith Brewer's paper on "Practice under the Modern Patent Law," Mr. F. E. Hamer's paper on "The Chemist in Relation to Public Life," Professor Armstrong's address on "The Education of the Chemist," and Mr. G. S. W. Marlow's lectures on "Contracts of Service," have been fully reported in the *Journal and Proceedings*. Dr. J. T. Dunn's lecture on "The Progress of Chemistry in Public Affairs," and Sir William Willcox's address on "The Influence of Chemical Research on Medicine and Forensic Medicine" have been published separately.

The special subjects which have come under the notice of the Council during the year include the Therapeutics Substances Bill, Patent Office Procedure, Status of Scientific and Technical Civil Servants, the Dyestuffs Industry, the Qualifications of Gas Examiners, Engineering Standards, National Certificates in Chemistry, and the Standardisation of Scientific Glassware.

The Students' Association in London has had a good year, the members paying many visits to important works and laboratories, and holding debates and other social functions which have been greatly appreciated. The visit of the Association to the British Empire Exhibition, in which over 350 students and friends participated, was the chief feature of its programme.

Institution of Petroleum Technologists

DURING the past year there has been a slight increase in the membership, which now stands at about 704. The Institution was represented in the Chemical Section of the British Empire

Exhibition at Wembley and took part in the Empire Mining and Metallurgical Congress held at Wembley in June. It is also represented on the British Engineering Standard Association, the Imperial Mineral Resources Bureau, the Fuel Economy Committee, the British Association for the Advancement of Science, the Committee of Birmingham University, which is responsible for the education of petroleum technologists, the American Society for Testing Materials. The Institution was represented on the occasion of the Centenary Celebration of the founding of the Franklin Institute and the Inauguration Exercises of the Bartol Research Foundation, which took place in Philadelphia in September.

The Journal of the Institution, which is published bimonthly, contains all papers read, contributed papers, a complete set of abstracts taken from papers and articles dealing with the petroleum industry, and a current bibliography. The report of the Standard Methods of Testing of Petroleum and its Products, published in May, is obtainable from the Institution.

The awards and scholarships given during the past twelve months are as follows :—

The Boverton Redwood Medal.—This award was made retrospective to 1919, and for that session, 1919-20, and 1920-21, the medal was awarded to M. Paul de Chambrier, of Pechelbronn. The medal will be presented in March, 1925. There were no papers of sufficient merit to warrant the award for the sessions 1921-22 or 1922-23.

Student's Medal and Prize.—The first award was made to Lieut. J. H. Blakiston, R.N.R.

Institution Scholarship.—Royal College of Mines student—Mr. Ernest Clark ; Birmingham University student—Mr. Geoffrey Cotton.

Oil and Colour Chemists' Association

THE year 1924 has been an important one in the history of the Oil and Colour Chemists' Association, since it has seen the incorporation of the older Paint and Varnish Society with the Association. This step has resulted in the creation of a new class of membership—known as Associate Membership—in order to admit to the Association persons connected with the industry, but not in possession of definite scientific qualifications. This course was recommended by the Council, after full consideration, and it received the approval of the members of both societies. In their Annual Report, the Council have expressed their firm conviction that this amalgamation will be of benefit to the paint and varnish industries.

The membership of the Association has increased considerably during the year and good progress has been made. The Journal, which hitherto has appeared eight times a year, is now issued regularly once a month. One important feature of the latest issues, is the inclusion of a fairly complete bibliography, containing references to recent literature dealing with paint and varnish technology.

One of the most important events for many years, in connection with the paint and varnish industries, has been the appointment, by the British Engineering Standards Association, of a fully representative Committee, to draw up a series of British Standards for paint and varnishes used in the engineering and allied trades. This Committee, which was appointed in January, 1924, is under the Chairmanship of Dr. J. Newton Friend, the then President of the Oil and Colour Chemists' Association. Its constitution is such that the Association is well represented, both directly and indirectly. The Committee has divided up the work between the following three Panels :—

Panel 1. *Chairman*—Mr. C. A. Klein. A Vice-President of the Association. Pigments and other raw materials used in the manufacture of oil paints, paste paints, and paste driers, including nomenclature and methods of analysis.

Panel 2. *Chairman*—Dr. H. H. Morgan. President of the Association. Ready mixed paints and enamels : their composition, properties and methods of application.

Panel 3. *Chairman*—Dr. G. Rudorf. A member of the Association. Varnishes and the materials used in their manufacture : their properties and methods of application.

It is recognised that the task before the Committee is a long and difficult one, but a start has been made and the atmosphere of enthusiasm promises well for the future.

The Council has long felt that provincial members do not derive the same advantages from their membership as those resident within the London area. Steps are therefore being taken to remedy this state of affairs, so far as the Birmingham and Manchester areas are concerend, by the formation of local sections in those places. It would be particularly valuable to the Council if readers, interested in the formation of such local sections, would communicate with the General Secretary of the Association.

Among papers read at meetings of the Association during the past year, mention must be made of the following :—Dr. J. Newton Friend dealt with " Recent progress in the study of Corrosion," in an interesting and important contribution, published in January. The subject of Chromes was discussed by Mr. P. R. Koekkoek, from the point of view of the consumer. Messrs. C. A. Klein and J. Parrish contributed two further instalments dealing with their work on " The size of Particles, with special reference to Pigments," in which the position to date was reviewed, methods of investigation described, and results discussed.

At an Exhibition meeting held in April the " Stream-line filter and its application to the Oil and Colour industries " was demonstrated by Mr. J. A. Pickard, and a new form of " Daylight " lamp was exhibited by Mr. F. E. Lamplough. Others papers were concerned with the polymerisation of Linseed Oil, Dr. J. Newton Friend and Mr. H. J. Alcock describing their investigations, while Dr. R. S. Morrell discussed the theory at some length.

In the new Session, which opened in October, Dr. H. H. Morgan, the new President, dealt with the preparation and value of paint and varnish specifications ; while in November, Messrs. J. A. Frome Wilkinson and E. F. Figg presented a paper on the drying and water absorption of varnishes. The December meeting took the form of a joint discussion with the London Section of the Society of Chemical Industry, on the subject of protective paint coatings.

During the coming year there will be an exhibition of technical plant, whilst papers dealing with the painting of ships, with synthetic resins, with chrome pigments, with the paint and rubber industries, and with artists' colours have been arranged.

It will thus be seen that the activities of the Association are increasing, and that its work is bound to play an important part in the development of the industries as a whole.

The meetings of the Association are held in the Council room of the National Federation of Paint and Varnish Manufacturers, Trafalgar Square, and the members usually dine together prior to the meeting.

The present officials of the Association are :—President, Dr. H. Houlston Morgan ; Hon. Secretary, H. A. Carwood ; Hon. Treasurer, S. G. Clifford ; Hon. Editor, J. A. Frome Wilkinson, 89, St. John's Park, Blackheath, S.E.3 ; Gen. Secretary, J. H. Aiken, 30, Russell Square, London, W.C.1.

J.A.F.W.

Society of Chemical Industry

THE Society of Chemical Industry has during the past two or three years lost a considerable number of members owing to lack of employment, change of occupation and other causes. In order to make good these losses, an extensive propaganda has been initiated with the result that applications for membership are now coming in more rapidly than they have done for a long time. As a matter of fact, more new members were elected at the December Meeting of Council than on any single occasion since February, 1921. This change for the better has been very distinctly assisted by the decision of the Council to suspend the entrance fee in the case of members joining the Society during 1925.

The Council has continued to co-operate with the Council of the Chemical Society in establishing the Bureau of Chemical Abstracts, and a reciprocal arrangement has been made whereby the members of the one society are enabled to obtain the publications of the other on reduced terms.

The Society has taken a great deal of interest in the formation and carrying on of the Chemical Section of the British Empire Exhibition at Wembley, both financially and by arranging for the publication of booklets dealing with the various departments of Chemical Industry and the treatise on " Chemistry

in the XXth Century," the last mentioned being edited by the late President of the Society, Dr. E. F. Armstrong.

The Council was invited to organise the Chemical and Physical Section of the World Power Conference held during the Exhibition, and these arrangements were carried out by the Chemical Engineering Group of the Society.

The Society continues to be represented on a large number of outside bodies, including the Federal Council for Pure and Applied Chemistry, the National Physical Laboratory, the Imperial Mineral Resources Bureau, Sub-Committees of the British Engineering Standards Association, Joint Committee for the Standardisation of Scientific Glassware, the British Empire Sugar Research Association, and on the Governing Board of the Imperial College of Science and Technology.

The annual meeting of the Society in Liverpool was a most successful one, and the members and their friends were generously entertained by the Corporation of Liverpool, Lord Leverhulme, Messrs. Joseph Crosfield and Sons, Ltd., and the United Alkali Co., Ltd. An invitation to hold next year's meeting in Leeds has been accepted.

The Right Hon. Lord Leverhulme delivered the Second Messel Lecture, entitled, "Science, Religion and Workshop," on the occasion of the annual meeting in Liverpool.

In November a joint dinner of the society and the Chemical Industry Club was held in London, at which a large number of members of both bodies were present.

The Society has continued its policy of co-operating with kindred societies by holding many joint meetings at the various local sections, and in other ways.

The Honorary Membership of the Society was conferred on M. Ernest Fourneau of the Pasteur Institute, Paris, and on M. Armand Solvay, President of the Société Solvay et Cie., Brussels.

J.P.L.

Manchester College of Technology

Centenary Celebrations

THE Centenary of the Manchester Municipal College of Technology was celebrated last week. The College is now part of the Manchester University, and students of both are of equal status. Historically, the College is the successor to the Manchester Mechanics' Institution founded in 1824, in hired premises. About 1880 the effects of the Elementary Education Act began to operate and technical instruction was more seriously regarded. Textile manufacturers, engineers, chemical manufacturers, bleachers, dyers, and many others, agitated for the provision of a better and a higher standard of education for young men entering into their industries. In 1892 the Manchester Corporation assumed the full responsibility for what was then called the School of Technology. The School was erected in Whitworth Street, in 1903, at a cost of £380,000, its first Principal being Mr. John Henry Reynolds. The School became the Manchester Municipal College of Technology in 1918.

On Thursday, December 18, a large number of guests were entertained at luncheon in the College. VICE-CHANCELLOR SIR HENRY MIERS, proposing the toast of "The College," gave an outline of its history, and said that it had always adapted itself to rapidly changing conditions. Industrial problems could not always be solved in the industries themselves. Fundamental researches into the laws of nature were necessary, and in this work the College had distinguished itself. It was an example of the happy union of applied science with pure science.

PRINCIPAL MOUAT JONES proposed the health of Professor H. G. Jordan, who was retiring after 42 years of service to the College, and stated that the engineering industry was acknowledging the great debt it owed to him by electing him an honorary life member of the Manchester Association of Engineers. In responding, Professor Jordan said it was 52 years since he joined, as a young apprentice, the evening classes at the Mechanics' Institution.

On the following day a reception was given by the Lord Mayor and Lady Mayoress of Manchester, when about 2,000 guests attended to meet the Earl of Crawford and Balcarres, Chancellor of the Manchester University.

Proposed Extensions

THE LORD MAYOR OF MANCHESTER, in calling upon Lord Crawford to address the guests, mentioned that the governing body was contemplating a further extension of the College upon a site between Granby Row and Whitworth Street. It was proposed to erect new workshops, laboratories and lecture rooms at a cost approaching £250,000. Mainly owing to the energy and initiative of the late Principal, Dr. Maxwell Garnett, £120,000 had already been promised, and £60,000 of that sum had already been paid. It was confidently anticipated that the Corporation of Manchester would make themselves responsible for the balance.

LORD CRAWFORD said that to-day the College ministered to 6,000 students, while there were 50,000 old students scattered all over the world. One thing caused him to feel most particular satisfaction; the good, sensible, working alliance which had been effected between the College and the University of Manchester. Each supplemented the other, neither would nor could be so strong in isolation, and the resulting combination of original research and applied science was a most happy one. Many young men asked themselves whether this high standard of technical education was essential for their future welfare. Often it was seen that untrained men obtained higher remuneration than those who were trained and skilful. Learning was always worth while if only for learning's sake; but, more than that, it was worth while for character, for self-discipline and control, and study never failed to repay itself in the long run.

The Merchant's Place in Industry

Evidence before the Industry and Trade Committee

AT the seventh meeting of the Committee on Industry and Trade held on Wednesday, December 17, Mr. F. T. T. Reynolds (Millwards Merchandise, Ltd.), representing the Manchester Association of Importers and Exporters, gave evidence with regard to the position and functions of merchants in respect of distribution, both overseas and at home. He also spoke on the adverse effects on British export trade of shipping and transport charges. Other matters dealt with were port dues and handling charges and local rates and service charges.

Mr. REYNOLDS said that the position of the British chemical industry reflected great credit on the manufacturers. In heavy chemicals British ascendancy was more than fully established. The Empire could breathe more freely now that it was known that the successful exploitation of the atmosphere for nitrogenous compounds would soon ensure independence of external resources for commodities essential in times of peace or war.

It was quite clear that, rightly developed, there existed within the Empire, actually or potentially, besides foodstuffs, cotton, wool, timber, coal, and minerals, most of the raw materials required for the making of finished chemicals and synthetic dyestuffs and for the growing and effective preparation of natural dyes, tanning and sizing materials, gums, seed and nut oils, animal fats, mineral oils, ores, etc. He submitted that the work of developing these supplies could best be done on the basis of exchange of commodities, and the merchant trader was equipped for still more effective service than he had rendered in the past. Hitherto, during periods when British oversea trade had most flourished, it had been the merchants who had been the main distributing medium, and the merchant was among the factors that should be recognised and encouraged in the future. Much the same applied both to the oversea and to the home market. He therefore submitted :—

(*a*) That the position and functions of the merchant in respect of distribution is an established, integral, and valuable link in the chain of British trade, both oversea and in the home market.

(*b*) That the merchant provides the natural, effective, and generally most economical bridge between the source and the requirements and between the maker and the user.

(*c*) That, therefore, the merchant interest is entitled to proper recognition by the Board of Trade.

(*d*) That when consultations take place by the Board of Trade with representatives of the Manufacturers' and of the Users' Associations regarding existing and prospective legislation, or on trade matters generally, the merchant interest should be entitled to participate in such consultations, and in a similar manner to the other interests vitally concerned.

(*e*) That the appropriate Merchants' Association should be represented on the Dyestuffs Advisory Licensing Committee,

and on any other trade committee set up with either advisory or executive powers.

Mr. Reynolds also criticised the administration of the Dyestuffs (Import Regulation) Act, 1920, and maintained that there was abundant evidence in the reparation importations and the importations from Germany of dyestuffs under licence that the effort to make Great Britain self-contained regarding dyestuffs had not so far fully succeeded; and there was plenty of evidence that in the meantime we were losing part of our export trade in finished textile fabrics. Under the operation of the Dyestuffs Act, unfortunately, prices current in Great Britain, and restriction in choice, placed users in many cases at a great disadvantage as against their competitors abroad. He also submitted that the Safeguarding of Industries Act had been badly drafted and insufficiently considered by Parliament. Its operations resulted in delay at every turn and constant anxiety and uncertainty for importers.

With regard to the levy of 26 per cent. under the German Reparation (Recovery) Act, 1921, importers were strongly of opinion that the present method of recovery should be discontinued and arrangements made for collection by the German Government, who would pay in bulk to the British Government on fixed periodical dates. By such means the British Government would continue to receive the full amount of the levy, while importers would be freed from serious trouble, delay and loss.

United States Potash Supplies

To be Safeguarded by By-product Processes

ENORMOUS potash reserves—certain, it is declared, to free the American farmer from danger of foreign exploitation are revealed in a report of federal surveys to the American Chemical Society by Dr. J. W. Turrentine, of the Bureau of Soils, U.S. Department of Agriculture.

"The greensands of New Jersey, the potash shales of Georgia, the leucites of Wyoming, and the alunites of Utah, contain in the aggregate," the report asserts, "inexhaustible quantities of potash, and methods of recovering it therefrom are now much nearer solution than is generally recognised. The problem again is one of by-products. In most of these raw materials aluminium is an important constituent. Great progress is being made in the development of methods for its recovery as alumina as a raw material for the aluminium industry. From such a mineral as alunite the solution of this problem will mean also the solution of the problem of the economical recovery of potash therefrom, and the same, it now appears, will prove to be the case with the potash shales, felspars, leucites, and greensands. In present researches emphasis placed on alumina, instead of on potash exclusively, as in the past, has brought the solution of the problem within sight. For some time we have known how to obtain the potash. We now know how to obtain both potash and alumina and in one important instance, greensand—still other products of value. Results now in hand warrant the expectation that all of these materials can with some further research be made to yield their quota to the nation's potash supplies.

"Finally, the observations recorded in the *Texas Panhandle* showing unmistakable evidence of subterranean potash deposits convince us that in some one of these three groups of raw materials, if not in all of them, adequate quantities of potash will be produced, certainly to render the American farmer free from danger of unrestricted exploitation by foreign monopoly, if not to supply the nation with its entire requirements in respect to that essential commodity. Potash manufacture in this country has developed so rapidly since the war that it is now able to meet successfully the competition of the European product placed on our seaboard under the severest competitive conditions ever experienced in this industry.

Why Depend on Europe?

"Surveys have just been completed of the alcohol, cement, borax, and blast furnace industry 'showing a total tonnage of potash there producible of 225,000 tons.' Omitting the borax industry, 150,000 tons are being thrown away annually as a waste product. Methods have been devised, it is announced, to recover this wastage. 'Where,' asks Dr. Turrentine, 'is the logic in going to Europe for our potash while we are throwing away as a waste product of our industries our practical requirements?' The task ahead, it is stated, is the development of this by-product potash industry just as ammonium sulphate was developed as a by-product of the coking industry, the yield of by-product ammonia advancing from nothing to a yearly output of over 600,000 tons. What has happened in the coking industry," adds Dr. Turrentine, "it is our hope to see duplicated in the blast furnace, the cement, the sugar, and the distillery industries. The affirmative results already obtained in governmental and private researches convince us that this is an entirely reasonable expectation."

The Casale Synthetic Ammonia Process

List of Licensees and Their Activities

THE first complete list of licensees of the Casale process for the production of synthetic ammonia has been obtained by Mr. A. A. Osborne, assistant commercial attache at Rome, and is given in a special report to the Chemical Division of the United States Department of Commerce. In addition to the license held by the Ministry of War for the 20-ton plant at Toulouse, other licenses have been extended in France as follows: Cie de Produits Chimiques and Electrometallurgiques Alais Froges and Camargue, two 1-ton units being operated at St. Aubun; Cie des Mines de Dourdes, two 7·5-ton units in construction; Société des Mines de Lens, three 7·5-ton units in construction; Cie des Mines de Vicoigne Noeux et Drocourt, two 7·5 ton units under construction; Cie des Produits Chimiques de Roche la Moliere, two 7·5-ton units under construction; Cie des Mines de Sarre et Moselle, two 7·5 ton units under contract.

Japanese rights have been obtained by Japan Nitrogen Fertiliser Co., Osaka, which is operating four 7·5-ton units at Nobeoka and estimates have been requested for three 15-ton units. The Spain licensee is Energia y Industrias Aragonesas, with two 7·5 ton units at Sabinanigo. In Switzerland the Ammonia Casale Co. and Usines Electriques de La Lonza have licenses and two 3·5-ton units are under construction. The Societa Italiana Ammoniaca Sintetica has Italian license, operating two plants, one at Terni and one at Nera Montoro, the latter to be increased to 30-tons ammonia per day. In Belgium the S. A. des Fours a Coke Semet Solvay and Piette has two 7·5-ton units under construction. The Ammonia Co. of New York is operating two 7·5 ton units at Niagara Falls and assembling a third, and holds a general license, but fertiliser rights are excluded. Fertiliser rights are held by Hydroelectric Chemical Co., New York. Washington Irrigation and Development Co. is contemplating operations under the Casale patents at Priest Rapids on the Columbia River in Washington.

The utilisation of this process received impetus by the recent action of the French Government in deciding in its favour after having paid 5,000,000 francs for the Haber-Bosch rights and deciding to equip half of the Toulouse plant with another process.

Nitrogen Fixation in Italy

Post-War Developments in Commercial Processes

SINCE the war Italian chemists have been directing their attention to the discovery of a commercial process, based on the Haber method, for the fixation of nitrogen, and two processes, known as the Casale and Fauser respectively, have been worked out, says *The Times Trade Supplement*. Two small industrial plants were established some years ago at Terni and at Novara for utilising these processes, and that of the Montecatini Company at Novara, where the Fauser method was adopted, proved so successful that last year it was decided to embark on an extensive programme of production.

The activities of the Montecatini Company, with a capital of 200,000,000 lire, are chiefly devoted to mining and the production of artificial manures. The undertaking possesses and works iron pyrites, ignite, and peat deposits, mercury mines and marble quarries in Tuscany, sulphur mines in Sicily, and lead and zinc mines in Sardinia, and it also produces superphosphates, sulphate of copper, and calcium cyanamide.

For working the Fauser process on a large scale it has formed a subsidiary company, the Società Elettrica Alto Adige. A hydro-electric installation of 40,000 kw. will be ready in the Italian Tirol next spring, together with plant capable of producing 30 tons a day of nitrates (nitric acid, nitrate of ammonia, and for the most part sulphate of ammonia). Another factory is being established simultaneously in Sardinia, to which power will be supplied from the Tirso plant and subsequently from a new hydro-electric station that is being constructed on the River Coghinas. Its initial capacity will be 10 tons daily, so that the total production from the new works will be 40 tons daily, or approximately 14,600 tons per annum, capable of being increased to 20,000 tons. Last year the Italian consumption of nitrates amounted to 19,000 tons, of which 7,000 tons was represented by calcium cyanamide, but it is considered certain that before many years have passed the consumption will reach 60,000 tons. In the meantime the great Sila hydro-electric plants (300,000 h.p.) will come into operation in the south of Italy, and the Montecatini Company have already secured a site at the Port of Cotrone for the erection of larger works in anticipation of future Italian demands and even the possibility of exporting to foreign markets.

Magadi Soda Co., Ltd.

Scheme to Develop Resources of Kenya

In the Chancery Division on Saturday last Mr. Justice Eve sanctioned a scheme of arrangement between the different classes of shareholders and debenture holders of the Magadi Soda Co., Ltd., which has a concession of soda deposits in the Kenya Colony, East Africa. Counsel in submitting the scheme said it was to be financed by Brunner, Mond and Co., Ltd. At the various meetings called to consider it, if the official receiver was right in rejecting certain proxies, there was a large majority—three-quarters—in favour of the scheme, and even if he was wrong there was a three-quarters majority of every class of deferred shareholders. The scheme provided that the existing company was to be wound up and a new company of the same name was to be incorporated with a share capital of £830,000 divided into 250,000 6 per cent. preference shares of £1, 1,320,000 6 per cent. second preference shares of 5s., 600,000 preferred ordinary shares of 5s., and 100,000 ordinary shares of £1. The £250,000 preferred shares were to be applied towards satisfying the unsecured creditors and the second debenture holders, the ordinary and the deferred shares would have certain rights in the 6 per cent. second preference shares, and the ordinary shares would be subscribed for by Brunner, Mond and Co. It was provided that the company was to create an issue of £500,000 first debentures at 6 per cent. repayable in 1945 or earlier but not before 1929 at the rate of 105 for every 100. Counsel submitted that the scheme was fair and just. No scheme could go through unless a third party was found to finance the company and to give satisfactory guarantees to the Colonial Office that the resources of the Kenya Colony would be developed.

Mr. Bennett, K.C., said he supported the scheme on behalf of debenture holders to the extent of £61,000.

Mr. A. P. Pennell, a deferred shareholder, said the scheme did full justice to the debenture holders but was most unfair to the deferred shareholders.

His Lordship said the answer to Mr. Pennell was that the scheme had been approved by substantial majorities of the different classes of persons affected by it. He proposed to approve the scheme subject to this, that the question as to who were to be the trustees for the debenture holders would be settled by him at a later date.

Russian Oil Products Prices

Motor Spirit.—The wholesale price of R.O.P. motor spirit in tins for deliveries in the London zone are now as under: R.O.P. No. 1, 1s. 3d.; R.O.P. No. 2, 1s. 1d.; R.O.P. Special Boiling Point, 1s. 3d. Barrel prices are ½d. per gallon less and the bulk prices are 1½d. per gallon less. For the remainder of England and Wales prices are 1d. per gallon dearer. Prices in Scotland are 2d. per gallon dearer.

Kerosene.—R.O.P. Prime White delivered in bulk in the London area, 8½d. per gallon; barrelled oil, ex wharf, 3d. per gallon above bulk prices. For the rest of England, Wales, and Scotland 1d., and Ireland 2d., per gallon extra.

Masters and Men in Conference

An Example of Co-operative Industry

The dinner given by Naylor Brothers (London), Ltd., the well-known paint and varnish manufacturers, at the Castle Hotel, Windsor, on Friday evening, brought to a close the annual conference week, during which the directors, heads of departments, representatives, and technical staff discuss together the problems of the industry. This excellent plan, we understand, was started just after the war, when the firm was confronted with new conditions, and it was decided to bring the collective mind of the whole staff to bear upon them. Among many other developments, it led to the practice of marketing all the firm's products under its own name and in its own receptacles, instead of the former practice of selling in bulk to wholesalers who made the goods up under their own name. Every year a whole week is given to a serious review of the business, from the commercial, technical, salesmanship, and publicity points of view, and the results are as welcome to the staff as to the firm, for it gives them an opportunity of personal acquaintance and of co-ordinating their activities. It is satisfactory to find that the chemical department is not the least important, and the papers presented during the week included one by Dr. H. H. Morgan, who is the president this year of the Oil and Colour Chemists' Association. The note of the whole conference is a readiness to welcome new ideas, and to adopt improvements making for efficiency in production and marketing.

The representatives and guests on Friday evening were received by Mr. H. Spencer Naylor, managing director, who afterwards presided. In proposing the toast of "The Representatives," Mr. Naylor referred to the loyalty of the staff, to the excellent relations between them and the firm, and to the general desire of all to co-operate for the success of the business. Mr. J. Gorry, who responded, acknowledged the splendid way in which the representatives were supported by the board and by the other departments, and said their work was made easy, even in these competitive days, by the excellence both of the firm's products and of the firm's organisation. The prize for the most successful representative fell to Mr. Porter (Yorkshire), who remarked that Yorkshire's verdict on the firm's products was the best tribute to their quality. Mr. G. G. Craig proposed "The Ladies and Guests," to which there were several responses. There was a pleasant musical programme, to which a quartet, composed of gentlemen of H.M. Royal Chapels, contributed.

New Finish for Cotton Threads

If cotton is treated with highly concentrated nitric acid in the presence of products formed by the action of nitric acid on cellulose, starch, or protein, a shrinking of the fabric takes place, but at the same time a crimping and roughening of the threads occur. The fabric so treated resembles in appearance and feeling more a woollen fabric than a cotton one. This new process (the Berlin correspondent of *Industrial and Engineering Chemistry* states), which was discovered by Ch. Schwartz, produces a new form of finish to the cotton threads. According to information from Dr. Beil concerning this new process, which is called "philanizing," the threads so treated show a greater affinity for dyes as is the case with mercerized threads. Aside from the more beautiful appearance and the softer feeling of philanized threads, the yare more durable. It is true that philanizing offers many difficulties in practice, as one must work with highly concentrated nitric acid, so that it can only be carried out in chemical plants. The Höchster dyeworks, with their enormous plant for the production of nitric acid, have been operating the process for several months. The philanized material is then finished in the textile finishing works, the dyeworks, and the print works. Coloured fabric which is dyed with indanthene and other vat dyes, as well as yarn, loose cotton, or roving, can be philanized. It is thought that new articles of this material will be put on the market, which will occupy a place between the cheap cotton and the expensive wool.

From Week to Week

THE GRASSELLI MEDAL FOR 1924 has been awarded to Dr. B. D. Saklatwalla, of the Vanadium Corporation of America.

ONE FATAL ACCIDENT OCCURRED in the chemical and allied industries during November, two in the clay, stone, glass, etc., industries, and one in textile bleaching and dyeing trades.

FOUR DEATHS DUE TO LEAD POISONING and one due to arsenic poisoning are recorded during the month. In addition seven cases of lead poisoning among painters and plumbers were reported during November.

CHLORINE GAS TREATMENT FOR COLDS has been tried at the General Electric Works at Schenectady, New York. The works employ over 20,000 and after a ten-day test cures were reported to the extent of 75 per cent. of the sufferers.

OWING to a printer's error in the advertisement of Sofnol, Ltd., appearing in our issue of December 20, the hardness of water before treating with Sofnol Lime-Soda Mixturew as mentioned as 6.28° instead of 16.28°.

TRADE DISPUTES IN THE CHEMICAL INDUSTRY for the first eleven months of this year numbered nine, involving 1,000 workers and an aggregate of 22,000 working days lost. For the same period of last year the figures were: disputes, 14; workers involved, 2,000; and days lost, 31,000.

MAGDALEN COLLEGE, OXFORD, announces that Mr. Herbert Isaac Coombs, B.A.,,B.Sc., Rhodes scholar in the College from the University of Adelaide, South Australia, has been elected to Senior Demyship in Bio-chemistry. Mr. Coombs is pursuing research in bio-chemistry under Professor Gowland Hopkins, at Cambridge.

MEMBERS of the Newcastle Section of the Society of Chemical Industry visited the glass works of J. A. Jobling and Co., Ltd., of Millfield, Sunderland, last week. Considerable interest was taken in the manufacture of "Pyrex" glass which, it is claimed, is practically unbreakable, will stand the melting of lead, resists acids, and does not fracture on sudden cooling.

A CONTRACT FOR £200,000 has been placed with a Sheffield firm by the Blackwell Colliery Company, of Alfreton, Derbyshire, for the supply and erection of a battery of 40 regenerative taper ovens for the making of coke, tar, crude benzol and sulphate of ammonia. It will be one of the largest batteries of the kind in the country. The plant will include a coal washery and mechanical devices for loading and screening coke.

THE PREMIER OF TASMANIA has made an important announcement regarding the shale oil industry in Tasmania. He states that the Government has decided to reserve for the State those areas in which shale was likely to be found which had not yet been alienated. The Government is also considering the granting of an area to the Bronde Australian Shale Corporation in order to allow this concern to carry out tests. The shale deposits are estimated to be worth £150,000,000, and are situated mainly on the north-west coast.

ARGENTINE'S HEAVY CHEMICAL and drug trade during 1924 has been normal with a tendency to improve, according to the *Board of Trade Journal*. The Argentine is a great importer of chemical products for her various expanding industries, and although British manufacturers have received a fair proportion of the trade, there are certain lines which it has only been possible to import from Germany, on account of considerably lower prices. In addition, there is a certain amount of competition from the United States, but not to the extent of that from Germany.

A JOINT MEETING of the London Section of the Society of Chenical Industry and the Chemical Engineering Group will take place in the hall of the Royal Society of Arts, John Street, London, W.C.2, on Friday, January 16, 1925, at 8 p.m. A discussion on "The Low Temperature Treatment of Bituminous Materials" will be led by a paper by Mr. T. W. Stainer Hutchins; Dr. C. H. Lander, Director of Fuel Research, will also speak. The chair will be taken by Mr. C. S. Garland, Chairman of the Chemical Engineering Group, who will be supported by Dr. Bernard Dyer, F.I.C., Chairman of the London Section.

SIR MAX MUSPRATT has promised to read a paper before the Society of Chemical Industry early in 1925.

THE HARRISON MEMORIAL PRIZE Selection Committee is unable to make an award of the Harrison Memorial Prize for 1924.

THE MEETING of the British Association of Chemists, held in Liverpool recently, took the form of a conversazione and lantern lecture.

LORD CULLEN OF ASHBOURNE, having resigned his seat on the board of the Pan de Azucar Nitrate Co., Mr. M. H. Napier, managing director of Baburizza and Co., Ltd., has been elected to fill the vacancy.

UNEMPLOYED INSURED WORKERS in the chemical industry during November numbered 7,501 males and 1,444 females—a total of 8,945. This represents a slight increase over the figures for October in the case of both sexes.

AT THE INQUEST on the death of an oiler and greaser employed at Bury's Dyeworks, Adelphi, it was suggested that the stick and brush used in greasing caught, and the man was dragged on to a spoke of the flywheel and carried round.

MR. THURTLE, in the House of Commons, on December 18, asked the Secretary of State for Air whether his Department had given, or was contemplating giving, any orders to private firms for the manufacture of aerial bombs filled with poison gas. Sir S. Hoare said that the answer was in the negative.

REPORTS STATE that the Actien-Gesellschaft für Anilin-Fabrikation of Berlin is now able to produce an extensive range of colours for the dyeing of acetate silk. The company has filed a patent application for the dyeing process, first dyeing with acetate dyes, and then tapping with basic dyes.

SULPHURIC ACID is manufactured at Bordeaux, France, in four plants from pyrites received from Spain and Portugal, and phosphates from Algeria, Tunis and sometimes from the United States, says an official report. About 145,000 metric tons of phosphates and 55,000 tons of pyrites are imported annually for these four factories.

THE FOREIGN SAMPLES and Foreign Catalogues Section of the Department of Overseas Trade will be removed from its present premises at 7, Old Bailey, London, E.C., to 35, Old Queen Street, Westminster, S.W.1, during Christmas week. The exhibition of foreign samples will, therefore, be closed until the reopening at the new address on January 1, 1925.

THE SIXTH ANNUAL DINNER of the Midland Paint, Varnish, and Colour Manufacturers' Association was held at Birmingham on December 19. Appeals were made for the strong support of the British Industries Fair, to be held at Castle Bromwich, Birmingham, in February next. On that occasion the London Section of the Fair was to be added to the Birmingham and Midland Section, and it was hoped that the value to trade would be considerable.

ACCORDING TO an American Commercial Attaché at Berlin the "competition by the leading dye-producing countries outside of Germany is regarded as particularly keen, especially that of America. It is known that America and Switzerland are selling in the East Asian markets, where Germany was foremost in the past. British competition is not feared so much, as the Germans consider British prices are too high to compete in the open world market. The German industry still has to recover from the effects of the Ruhr invasion."

DR. A. B. LAMB, of Harvard University, former director and now consultant of the United States Government nitrogen laboratory, is handling the royalty arrangements, licensing, and other details connected with patents obtained by employees of the fixed nitrogen laboratory. The patents are held in trust for the laboratory employees, all of whom share in the royalties. Under the trust arrangement, however, the Government has a right to a non-exclusive license under any and all of the patents so held, says *Drug and Chemical Markets*. Fourteen patents have been issued to laboratory employees since 1921.

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Abstracts of Complete Specifications

224,923. Tin Ores, Concentrates and the Like, Metallurgical Treatment of. H. Edwards, Latton Lodge, Caversham, near Reading, Berks. Application dates, May 15 and 28, 1923.

This process is for smelting tin ores, concentrates, or the like, containing oxide or tin, with lead sulphide or other heavy metal sulphide, to obtain a matter which is then reduced to obtain an alloy of tin and lead. The tin ore may be subjected to preliminary roasting and sintering. Lead sulphide may be used in the form of galena, lead sulphide ore, tailings, or concentrates. A flux is added to form a slag with the gangue, and the mixture smelted to produce a lead-tin matte. This matte may be reduced by means of metallic iron, preferably in the form of tin-plate scrap, so that the tin in the scrap is added to the tin in the matte, and is thereby recovered. In an example, a tin ore concentrate containing arsenical pyrites and a silicious gangue, containing above 15 per cent. of tin, is first roasted to eliminate the arsenic and convert the iron sulphide into oxide. The ore and lead concentrate are then smelted in a reverberatory furnace in a reducing atmosphere. The proportion of lead to tin should be at least 6 to 1. The iron oxide in the concentrate provides the flux, but additional iron oxide or other flux may be added if necessary. Tin-plate scrap is also added to the charge to reduce the sulphides. The product is a tin lead alloy which may be separated as required, or employed as an alloy.

224,925. Dyeing or Colouring of Products made with Cellulose Acetate. British Celanese, Ltd., formerly British Cellulose and Chemical Manufacturing Co., Ltd., 8, Waterloo Place, London, S.W.1, and G. H. Ellis, of British Celanese, Ltd., Spondon, near Derby. Application date, May 22, 1923.

Specification No. 219,349 (see The Chemical Age, Vol. XI, p. 221) describes the use of colouring matters which have an affinity for cellulose acetate, but which are practically insoluble in water. These substances are converted into solubilised modifications by treating them with higher fatty acids or sulphonated or other derivatives containing salt-forming groups, such as the sulpho group or the carboxyl group, or with the sodium or other alkali or ammonium salts of these. Sulpho-ricinoleic acid was particularly specified. A large number of dyestuffs may be treated in this manner, such as dyes of the azo class, unreduced colouring matters of the aryl or substituted aryl benzo or naphtho-quinone monoimide series, and a number of others. It is now found that these insoluble dyes may be solubilised by means of carbo-cyclic compounds containing in their structure one or more salt-forming groups, or sodium or other salts of these compounds. These agents may be employed wholly or partly in place of the solubilising agents previously used.

These carbo-cyclic compounds include in their structure one or more salt forming groups such as the sulphonic, carboxyl, or hydroxyl groups. Examples of the compounds employed are phenols, sulphonic acids, carboxylic acids, phenol sulphonic acids, or other derivatives of the benzene, naphthalene, or anthracene series containing these groups; also derivatives of other cyclic hydrocarbons, saturated or unsaturated, containing one or more of these groups such as the naphthenic acids, naphthene sulphonic acids, or other carboxylic or sulphonic acids of the cyclo-paraffins, or the sodium or other salt of these derivatives. The soluble dyestuffs may be made by grinding or mixing the solubilising substance with the colouring matter, or by heating with or without water. In dyeing cellulose acetate, the solubilised substance is dissolved in water and filtered into the dye bath. If the colouring matter and solubilising agent are of such a character that a salt or lake might be formed, the solubilising agent is used in sufficient excess to ensure solution. If the azoic process is employed, the solubilising agent should not be capable of acting as a component which would alter the shade. Examples are given of the treatment of metanitrobenzene-azodiphenylamine with naphthenic acid; l-methylamino-4-paratolyl-aminoanthraquinone with naphthenic acid; benzene-azo-benzene-azo-β-naphthol with sodium sulpho-ricinoleate, paracresol, and sodium oleate; paramethoxy-benzene-azo-β-naphthol with sulpho-ricinoleate, l-hydroxy-4-naphthalene sulphonic acid, and sodium oleate.—

224,928. Refining of Oils and Fats. Lever Bros., Ltd., Port Sunlight, Cheshire, and R. Craig, "Benmore," Bromborough, Cheshire. Application date, May 24, 1923.

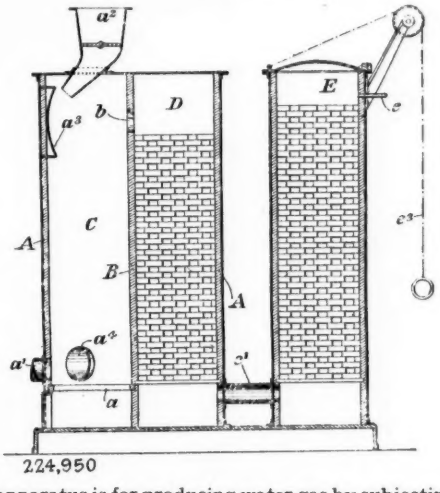
The object is to refine oils and fats containing free fatty acids to obtain edible oils of high quality without the use of alkalis. It has been found that the usual coagulants such as aluminium salts and alum are not satisfactory as coagulants in a process where alkali is not used. In this invention, the oil or fat is subjected to the action of acid-treated bleaching earth, to remove impurities which can be precipitated or coagulated. These are filtered off, and steam passed through the oil at a low absolute pressure with exclusion of air to remove the free fatty acids and deodorise the oil.

In an example, crude palm kernel oil containing 5 per cent. of free fatty acids is treated with 4 per cent. of "Tonsil A.C." to coalgulate impurities. The mixture is then heated to 95° C. for two hours, and the oil then filtered. Steam is then passed through the heated oil at 7 lb. absolute pressure for two hours to eliminate the free fatty acids. The oil should be at 245°–285° C., and the pressure above its surface should be about 1 inch of mercury, while air must be excluded until the oil is cooled. In this manner an edible oil of high quality may be obtained, containing only 0·01 per cent. of free fatty acid.

224,935. Centrifugal Purifying and Dehydrating Apparatus. A. W. Empson, 39, Victoria Street, London, S.W.1. Application date, July 21, 1923.

This separator is of the kind in which a central rotating member carries a series of superposed conical discs, the uppermost of which is the "discharge disc." The liquid to be purified and dehydrated passes downwards through the central shaft, and then outwards over the lowermost disc into the separating space. The lowermost disc or the carrier which supports it is provided with a flange extension whice leaves only a narrow annular space between its edge and the outer casing. The mixture of liquid, *e.g.*, oil and water ih thus intimately mixed in passing around the extension flangs so as to effect a washing of the oil before separation. A counter colloid may also be introduced.

224,950. Water Gas, Apparatus for the Manufacture of. P. Dvorkovitz, 11, Bassett Road, North Kensington, London. Application date, August 20, 1923.



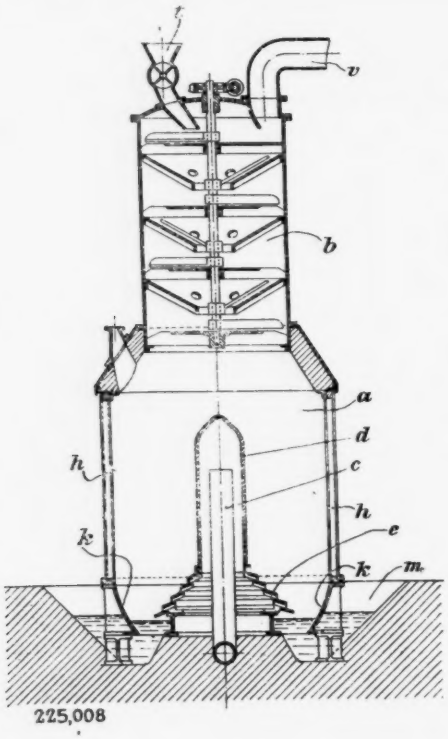
224,950

This apparatus is for producing water gas by subjecting coke, coal, or other carbonaceous material in a finely divided condition to the action of heat in the presence of oxygen and hydrogen. These gases are generated by the decomposition of steam in a chamber containing checker-work which is heated

by the hot gases from the fuel. The fuel may be pre-heated to remove moisture and other volatile matter before gasifying. The steam is subjected to a temperature of 1,000°–1,100° C. to dissociate it into oxygen and hydrogen. The chamber *A* is divided into two compartments by partitions *B*, the first compartment *C* constituting the generator, and the second compartment containing checker-work. The fuel is delivered through a valve-controlled hopper a^2 against a deflector a^3, and falls on to the fire bars *a* at the bottom. Air is forced through the inlet a^1 to render the fuel incandescent, and the hot gases pass through the opening *b* in to the checker-work compartment and thence through the pipe e^1 into the preheater *E*. A valve in the outlet a^4 is then opened, and steam is passed through the pipe *e* into the preheater E, and thence through the pipe e^1 into the compartment *D*, where it is dissociated into oxygen and hydrogen by the hot checker-work. This gas then passes through the open *b* into the generator *C*, in which water gas is generated and passes out through the opening a^4. This apparatus is suitable for treating carbonaceous matter which is usually not considered suitable for the manufacture of water gas.

225,008. Gasification of Coke Breeze and the Like. T. R. Wollaston, 26, Corporation Street, Manchester. Application date, October 2, 1923.

The apparatus is for gasifying coke breeze, fine coke, coke dust from coke screenings, etc. The retort *b* is arranged above



225,008

the producer *a* and contains a vertical rotating shaft carrying rotating arms for distributing the material. The material passes from conical shelves fixed at the periphery to alternate flat discs spaced at their peripheries from the retort wall. The blast pipe *c* for the producer is situated within a dome *d* above the grate *e*. The sides of the producer *a* are in the form of a water jacket *h*, for cooling purposes and generating the steam supplied to the blast pipe *c*. The lower end of the producer is shaped as shown at *k*, and enters a water seal *m* of suitable shape for the withdrawal of ash. In an alternative form, the bottom part of the producer is cylindrical, and a revolving ash extractor is provided. The coke breeze is supplied to the retort *b* through a hopper *t*, and the producer gas passes from *a* through the material in the retort *b* to an outlet *v*. The coke breeze in the retort is heated and dried by the passage of the hot producer gases for 20–40 minutes, and reaches the top of the producer at about 400°–450° C. The temperature in the producer rises to about 1,000° C. and is controlled by the water jacket *h*. The saturation temperature of the blast is about 68°–70° C., and pressure about 4–6 in. of water. This apparatus avoids the presence of dust passing out from the producer with the gas, such dust being intercepted by the retort *b*.

225,097. Yellow Colouring Matter of the Pyrazolone Series. L. B. Holliday and Co., Ltd., A. Clayton and J. A. Stokes, Deighton, Huddersfield. Application date, February 13, 1924.

This yellow colouring matter is obtained by mixing a solution of 2:6:8-naphthyl-hydrazine disulphonic acid with a strongly acid solution of sodium dioxy-tartrate, heating the mixture in stages, and allowing it to cool. 2:6:8-naphthylamine disulphonic acid is dissolved in water at 70° C., allowed to cool, and acidified with hydrochloric acid. The amino acid is diazotised with sodium nitrite, and then run into a solution of sodium bisulphite, and made alkaline with caustic soda. The mixture is then acidified with hydrochloric acid, and sulphuric acid is then added. The mixture is boiled to expel sulphur dioxide, cooled, and salted out, yielding 2:6:8-naphthyl-hydrazine disulphonic acid. The acid is mixed with water and sufficient soda ash to bring it into solution, and then treated with a solution of sodium dioxy-tartrate made strongly acid with sulphuric acid. The temperature is gradually raised in stages to 70° C., and the mixture then cooled to separate the colouring matter.

Note.—Abstracts of the following specifications which are now accepted, appeared in The Chemical Age when they became open to inspection under the International Convention:—202,997 (Chemische Fabrik auf Aktien vorm. E. Schering) relating to manufacture of resin-like products, see Vol. IX., p. 493; 206,152 (Etablissements Poulenc Frères and C. Oechslin) relating to hydroxylated aliphatic arsinic acids, see Vol. X., p. 19; 210,413 (Soc. of Chemical Industry in Basle) relating to intermediate products of anthracene series and dyestuffs therefrom, see Vol. X., p. 363; 213,249 (Rutgerswerke Akt.-Ges.) relating to de-creosoting of tar and tar oils, see Vol. X., p. 547; 214,628 (L. Cassella and Co. Ges.) relating to arsenic compounds of the aromatic series, see Vol. X., p. 681; 216,486 (Farbenfabriken vorm. F. Bayer and Co.) relating to manufacture of lakes, see Vol. XI., p. 124; 217,174 (E. Hinselmann) relating to treatment of fuels, oil shale, and other carbonaceous substances, see Vol. XI., p. 173.

International Specifications not yet Accepted

223,572. Zirconium Compounds. Soc. d'Etude des Agglomeres, 10, Rue Grange-Bateliere, Paris. International Convention date, October 17, 1923.

Zirconium ore is calcined at 1200° C., heated with a mixture of caustic soda and sodium carbonate, and the sodium silicate then dissolved out with boiling water. Any residual sodium silicate is then removed by washing with water containing sulphurous acid, leaving sodium zirconate which is converted into a solution of zirconium oxychloride by treating with hydrochloric acid, and some zirconium oxide. The latter residue, together with any unchanged ore, is treated with sulphuric acid to obtain zirconium sulphate. The zirconium oxychloride solution is treated with sodium sulphide to precipitate zirconia and iron, and sulphurous acid then added to obtain zirconium sulphite and redissolve the iron. The sulphite is dissolved in hydrochloric acid, and zirconium oxychloride crystals are then precipitated by saturating with hydrochloric acid gas. The oxychloride is treated with pure concentrated sulphuric acid, and the resulting sulphate is calcined at 500° C. to obtain pure zirconium oxide.

223,573. Refractory Products. Soc. d'Etude des Agglomeres, 10, Rue Grange-Bateliere, Paris. International Convention date, October 17, 1923.

Zirconium ore is heated in an electric furnace to a very high temperature and then discharged into water containing 0·1 per cent. of sulphuric acid. The material is then crushed, mixed with a binder consisting of 0·5 per cent. of dextrin or tar and 0·25 per cent. of boric acid or phosphoric acid or a salt, moulded, dried at 180° C., and then heated to a high temperature.

223,596. DYES. Farbenfabriken vorm. F. Bayer and Co., Leverkusen, near Cologne, Germany. International Convention date, October 18, 1923.

Fluorescein chloride or a derivative such as the dimethyl derivative is condensed with *v-m*-xylidine to obtain a phthalein dye. The condensation may be effected at 200°–210° C. in the presence of zinc oxide and zinc chloride, and the product ground, boiled in dilute hydrochloric acid, and washed. Yellow-red acid wool dyes are obtained by sulphonating.

223,601. SOAPS AND FATTY ACIDS. R. Vidal, 10, Rue de la Comète, Asnières, Sejne, France. International Convention date, October 19, 1923.

An oil, fat, fatty acid, or wax is treated with alkali in presence of alkali hypochlorite, aldehyde, or acetone, to obtain a soap. The soap may be treated with acid to obtain edible fatty acid. An example comprises a mixture of olive oil, earth nut oil, or oil of copra 120 parts, 40 per cent. acetaldehyde or formaldehyde 18 parts, sodium hypochlorite 10° Bé. 180 parts, and soda lye 36° Bé. 60 parts.

223,860. CONCENTRATING ORES. Minerals Separation, Ltd., 62, London Wall, London. (Assignees of C. H. Keller, and C. P. Lewis, 220, Battery Street, San Francisco, Cal., U.S.A.) International Convention date, October 23, 1923.

A mineral-frothing agent is used in conjunction with a freshly prepared alakli xanthate. The circuit liquor may be acid, neutral, or alkaline, and air in excess is used for agitation. Suitable frothing agents are cresylic acid, pine oil, naphthalene dissolved in xylene, creosote, and kerosene acid sludge, together with potassium or sodium xanthate.

223,873. INDIARUBBER. Revere Rubber Co., 355, Valley Street, Providence, R.I., U.S.A. (Assignees of J. McGavack, 141, 25th Street, Elmhurst, Long Island, U.S.A.) International Convention date, October 22, 1923.

In a process for making rubber compositions which can be moulded, crepe rubber is dissolved in carbon tetrachloride and chlorine is passed through till the rubber has dissolved twice its weight. A mixture of phenol and formaldehyde solution is then added to the rubber solution, which is heated in a reflux condenser for two hours. The mixture is then washed, pulverised, and dried at 95° C., and may then be moulded at a temperature of 175° C. and pressure of 3,000–4,000 lb. per sq. in. The phenol and aldehyde solution may be added to the rubber solution before chlorination or after partial chlorination, or may be added as a pulverised condensation product. Any of the usual fillers may be added to the mixture before moulding.

Specifications Accepted with Date of Application

212,865. Viscose, Process for the production of. L. Lilienfeld. March 15, 1923.

213,575. Alloys and metals, Process of improving. Metallbank und Metallurgische Ges. Akt.-Ges. March 31, 1923.

222,088. Magnetic steels with a high content of silicon, Production of. F. Thaud and Soc. Electro-Metallurgique de Mont Richer. Sept. 22, 1923.

225,160. Cyanides from alkaline earth cyanamides, Process for the manufacture and production of. Fabriques de Produits Chimiques de Thann et de Mulhouse. November 24, 1923.

225,593. Titanium hydroxide, Preparation of. J. Blumenfeld and C. Weizmann. July 31, 1923.

225,595. Soap, Manufacture of. E. V. Schou. August 2, 1923.

225,617. Petroleum emulsions, Process for treating. A. G. Bloxam. (*W. S. Barnickel and Co.*) September 4, 1923.

225,678. Dyes of the anthraquinone series. British Dyestuffs Corporation, Ltd., J. Baddiley, and W. W. Tatum. October 23, 1923. Addition to 201,610.

225,687. Mineral raw materials, Process for the dispersal of—by chemical action. O. Reitmair. November 5, 1923.

225,751. Magnetic separators. H. H. Thompson, A. E. Davies, and W. Box. March 6, 1924. Addition to 206,610.

225,779. Ores and other minerals, Process of extracting valuable ingredients from. E. E. Hedges. May 26, 1924.

Industrial Sands

THE innumerable varieties of sand which have distinct commercial uses have prompted the production, by Mr. A. G. Curtis, of Westmoor Laboratory, Chatteris, of an orginal illustrated booklet dealing with all kinds of industrial sands and describing their particular properties. Mr. Curtis, who is an expert adviser on sands, clays and refractories, has brought under review no less than 60 varieties of sands. The list includes sands for aluminium casting, brass moulding, bottle glass-making, filtration, paint filling, etc., and every variety of sand used in industry can be supplied from this laboratory.

South African Alkali

The Output of Carbonate of Soda

THE *South African Journal of Industries* contains a lengthy report by the Board of Trade and Industries on the question of fiscal assistance to the South African Alkali Co., Ltd.

Some interesting facts are given, from which it appears that the output of carbonate of soda has varied considerably; the highest production was 6,779 tons in 1917 and in 1922 73 tons only, while for 3½ months of 1923, the output was 462 tons. The company was formed in 1912 to work on a deposit on the Government farm "Zoutpan" in the Pretoria district. It has overcome the initial difficulties of production, now claiming to produce 150 to 160 tons per month, which they assure the Board could rapidly and easily be increased to 250. The sales have been very much less than the production in recent years, and prices (in Johannesburg) have been as follows:—

1921.—261 tons at £16 os. od., less 5 per cent.
1922.—153 ,, ,, £13 os. od., ,, ,,
1923.—117 ,, ,, £12 os. od., ,, ,,
1924.— 44 ,, ,, £12 5s. od., ,, ,,

The result is that a large stock of soda—no less than 900 tons, or some four months' supply of the whole Union—has accumulated. Good salt has been produced, but slightly inferior in colour, the cause of which has now been discovered and corrected, but further capital must be expended in order to produce salt of a high quality on a large scale, sufficient to supply the demand of the Union for dairy and table salt.

Imports of Competitive Products

During the last five years the imports of carbonate of soda into the Union have been as follows:—

	Tons (short)	Value (£)
1919	1,613	10,511
1920	3,320	24,244
1921	1,295	9,679
1922	3,336	19,489
1923	2,323	12,910

Comparing these with the production figures, it may be concluded that the requirements of the Union are about 3,000 tons a year or 250 tons a month, the whole of which can be produced by this company. As regards caustic soda, it would appear that the imports are about the same in quantity, and that the value last year was rather under £25 a ton, f.o.b. Ot this the company considers that it could produce 60 per cent. in the near future, and the whole later, which, with the carbonate of soda, might give a gross yield of nearly £100,000 a year at the factory, taking the f.o.b. price of the imported article as equal to the factory price at the pan. As regards salt, South Africa imported in 1923 379 tons of dairy salt, mostly from Britain, at an average price of £4 9s. 6d. f.o.b. per short ton, and 496 tons of table salt (90 per cent. of it from Britain) at an average price of £25 1s. 3d. per short ton. The company proposes to produce some 250 tons of salt a month, varying in price from £2 or £3 for common salt to £20 for the finest table salt in bulk. On the whole it is not beyond the region of possibility that the company should produce commodities to the value of some £120,000 a year not at present produced in South Africa. There appears to be no danger that the yield of the pan will be exhausted. Dr. Wagner estimates the capacity of the pan at a depth of 30 ft. at 110,000 tons soda and 180,000 tons salt, and at a depth of 94 ft. at 250,000 tons soda and 580,000 tons salt.

Arsenic in Foodstuffs

SIR E. HUME-WILLIAMS (House of Commons, December 17) asked the Minister of Health if, when framing the new Regulations relating to the use of preservatives in food, he would extend the Regulations so as to make it an offence to use arsenic in the preparation of cocoa or ironground soapstone in baking powder, having in view that both substances so introduced constituted a danger to the public.

Mr. Neville Chamberlain said that, as at present advised, he proposed to confine the Regulations to carrying out the principal recommendations of the Committee on the use of preservatives in food. The scope of these Regulations would need material expansion to cover such points as those mentioned.

Germany's Aluminium Industry

THE German aluminium industry is essentially a war-time growth. The raw aluminium producing plants have long been regarded as of doubtful worth owing to the initial error of building them on the lignite deposits instead of utilising the cheaper hydro-electric power. The German Government owns a monopoly of production, and although under the pressure of demands from consumers it has expressed its willingness to remove the present ban on imports, it strongly favours the simultaneous imposition of duty of 10 per cent. on imported foreign material.

Germany's raw aluminium industry really dates from 1915. Up till then there was a domestic working-up industry, but the bulk of the metal was imported from Switzerland and France. Before the war the only German producer was the small plant at Rheinfelden, in Baden, with an annual output of 800 tons. War necessities compelled the development of production in order to meet the shortage of copper and tin, and the fact that bauxite was procurable within the frontiers of the Central Powers was a favourable factor. At the end of 1915 works at Rummelsburg, near Berlin, with an annual capacity of 3,500 tons, were put into operation, followed in January, 1916, by those at Horrem (capacity 3,000 tons), and in April, 1916, by those at Bittefeld (4,000 tons). In August, 1916, the erection of the Erftwerk was commenced, and this plant began operations during the following year, the productive capacity being 12,000 tons a year. The Lautawerk was also built during the war, and started up in 1918 with the same capacity as the Erftwerk. All these war-time plants were erected adjacent to large brown coal-fields, but the Innwerke, in Bavaria, which is now entering on its producing phase, is utilising hydro-electric power. Horrem and Rummelsburg closed down shortly after the Armistice.

New Processes Wanted

The future of the German aluminium industry will depend to a considerable extent upon the development of fresh processes of production. Authorities are studying the electro-thermic (direct smelting) method, which is intended to replace the electrolytic process as a possible way to increased production.

Cheaper Oxygen in Northern Ireland

UNDER the heading "Belfast's New Industry," *The Northern Whig and Belfast Post* reports the opening of the new oxygen plant erected at Sydenham Road, Belfast, by Liquid Air, Ltd., of Queen's Park, London. The works were opened by the Rt. Hon. J. M. Andrews, Minister of Labour for Northern Ireland, Mr. O. Simonis, chairman of the company, presiding.

In the course of his introductory remarks, Mr. Simonis pointed out that, as a result of the opening of the works, the price of oxygen in Belfast had fallen from £5 per 1,000 cu. ft. to between 40s. and 50s. This would enable Northern Ireland to compete with Great Britain in the important engineering industries dependent upon the use of compressed oxygen. The plant could produce 160,000 cu. ft. per week.

Declaring the works open, Mr. Andrews said that the oxygen-making industry would not only serve to give employment in itself, but would also serve to cheapen the cost of production in many of their important concerns in Northern Ireland. They were deeply grateful to the chairman and directors for establishing that new and important industry in their midst. As a Government and as a people they wished it all success.

Chile's Chemical Exports

THE following are extracted from the list of goods exported from Chile during the twelve months ended December, 1923 :—

		Quantities.		Value in 1,000 p.f.
Borax	(tonnes)	29,702	..	10,601
Chile saltpetre	,,	1,849,755	..	392,650
Coal	,,	12,321	..	364
Iodine	,,	636	..	16,111
Sulphur	,,	125	..	20

Current values recorded in nominal gold pesos fuertes, equivalent to 1s. 6d. Par of exchange, peso fuerte = 1s. 6d. Tonne = 1,000kg. = 2,204 lb.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette, &c.

Company Winding Up Voluntarily

LOCKYER (GEORGE) AND SON, LTD. (C.W.U.V., 17/12/24.) Meeting of creditors at the offices of Tribe, Clarke and Co., Albion Chambers, Small Street, Bristol, on Monday, January 5, 1925, 2 p.m.

Partnership Dissolved

SPEARING (C.) AND CO. (Charles SPEARING and Edwin Frank GREEN), dyers and cleaners, Bath Street, Belgrave, Leicester, as from October 2, 1924. Debts received and paid by E. F. Green.

New Companies Registered

GRAHAM, GILLAM AND CO., LTD., 4, Iddesleigh House, Caxton Street, London, S.W.1. Importers, exporters, manufacturers of and dealers in iron, steel, coal, minerals, chemicals, oils, petroleum, coal tar, etc. Nominal capital, £10,000 in 9,500 ordinary shares of £1 and 10,000 deferred shares of 1s.

TAROADS, LTD., 9, Victoria Street, London, S.W.1. Contractors for the treatment of roads with tar and other liquids. Nominal capital, £30,000 in £1 shares.

WITCHAMPTON PAPER MILLS, LTD, 46, Cherry Street, Birmingham. Manufacturers of and dealers in paper of all kinds, manufacturing chemists, etc. Nominal capital, £20,000 in £1 shares.

Company News

SANTA RITA NITRATE CO.—An interim dividend of 5 per cent., less tax, is announced, payable on December 18.

BENN BROTHERS, LTD.—The directors have declared a interim dividend of 6¼ per cent., less tax, payable on January 1.

ENGLISH CHINA CLAYS, LTD.—The directors announce an interim dividend on the ordinary shares at the rate of 4 per cent. per annum.

JOSEPH NATHAN AND CO.—A preliminary statement for the year ended September 30, 1924, shows that the net profits amount to £31,415, compared with £11,486 for 1922-23. The directors have decided not to resume payment of the dividend on the preference shares in the meantime, as they consider it prudent to maintain the finances of the company in a liquid state. If the present trading results are maintained, however, they anticipate resuming payment of "A" preference dividends in February or March.

Tariff Changes

BRITISH INDIA.—A Ruling provides that, when mineral lubricating oil containing non-mineral ingredients is imported into British India duty shall be payable at the rate of 7½ per cent. *ad valorem*, provided that the non-mineral ingredients do not exceed 5 per cent. of the total oil.

GERMANY.—The following goods may now be imported without an import licence :—Colouring earths (except yellow ochre, bolus, Sienna and Verona earths), and waste and by-products suitable for use as colouring earths ; crude artificial iron oxide. Magnesite (natural carbonate of magnesia), calcined or not. Gold, silver and platinum ores. Spence metal. Antimony oxide. Bronze colours.

The list of articles which may now be exported without licence includes numerous metals.

Our Market Features

OUR weekly prices and market reports have been held over this week owing to the short time between this and our last issue and the seasonal state of the markets. These regular features will be resumed next week.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

Mining and Metallurgy

PAPERS prepared for reading at congresses are, usually speaking, of the historical or "review" type, and do not lend themselves to discussion in the same sense as more specialised or more polemical contributions on theory or practice, such as are customary at the ordinary meetings of learned societies. It is just as well that this should be the case, as there is seldom much time for discussion, and, moreover, the audiences are seldom "keyed up" to the degree necessary for detailed criticism; in other words, the atmosphere of a congress is not conducive to the calm and dispassionate consideration of details. The recent Mining and Metallurgical Congress at Wembley was no exception to this rule, which has its manifest advantages.

The papers were, for the most part, things to be taken away and studied, rather than hastily considered and discussed, and indeed many of the memoirs were worthy of a permanent place in the library, as works of reference of a high order. This was especially the case in regard to the overseas papers on practice, which were veritable text books on their subjects, dealing exhaustively with the mineral resources of the Empire and the methods adopted for their utilisation. The three papers presented under this head contain practically complete accounts of the state of the mining and metallurgical industries of the Dominions.

Metallurgical Education in Great Britain

MINING is the older art and claims precedence of the younger art and science of metallurgy. Hence the chief seat of instruction in these arts in London is the Royal School of Mines, the title of which indeed ignores the very existence of metallurgy. Elsewhere, in Great Britain, both mining and metallurgy are, with one exception, hidden away and submerged in the general "faculties" of science. The exception is Sheffield, which alone of our Universities grants degrees in metallurgy. At the Congress at Wembley not the least valuable of the papers was that presented in the section of non-ferrous metallurgy by Professor Carpenter, and entitled "Metallurgical Education of University Rank in Great Britain." Professor Carpenter dealt chiefly with the Royal School of Mines, which, as everybody knows, forms part of the Imperial College of Science and Technology. The paper contains, however, a number of separate sections by collaborators which render it a complete and authoritative account of the present state of metallurgical education throughout the country. Professor Desch deals with the Faculty of Metallurgy of the University of Sheffield; Professor Turner contributes an account of the Metallurgical Department at the University of Birmingham; and Dr. Andrew deals with the Metallurgical Department of the Royal Technical College, Glasgow. Dr. Smythe describes the constitution and curriculum of the Armstrong College, Newcastle-on-Tyne, one of the component colleges of Durham University, and Professor Read deals with University College, Cardiff, a component of the University of Wales. The remaining sections are as follows: "Metallurgical Education in the Victoria University of Manchester," by Dr. Thompson; "The Department of Metallurgy, Leeds University," by Mr. Summers; "The Metallurgy Department, Liverpool University," by Professor Bannister; "The Metallurgical Department of the University College of Swansea," by Professor Edwards; and, finally, Mr. Heycock gives an account of the Goldsmiths' Metallurgical Laboratory, Cambridge University.

From the mere enumeration of the sections it will be seen that the paper contains a complete account of the present state of metallurgical education in the country, and, as such, it constitutes a valuable work of reference. It is a reproach often levelled at us that we do not provide adequate means for technological training. Dr. Carpenter's paper goes to show that, if anything, opportunities for University teaching in metallurgy are superabundant. It leaves aside, as indeed it should, being a review and not a polemic, the vexed question as to how far metallurgy can really be "taught" by laboratory courses and the hearing of lectures. It is only fair to say, however, that the Universities themselves do much to secure to their students access to actual works where, it is safe to say, they will learn more in an hour than they could do "in class" in a week, except in such favoured Universities as, for instance, Sheffield, which has a full-fledged "open-hearth plant" and electrical and crucible steel furnaces for its students to work with.

Automatics in the Foundry

THE International Foundry Trades' Exhibition, which was held at Birmingham during the past month, was remarkable not only for the impression which it gave of the ingenuity and solidity of machines and plant of British manufacture, but for the number of exhibits which came from abroad. This is the second exhibition of the kind which has been held in this country, and those who attended must probably have come to the conclusion that there is scarcely an operation associated with the foundry for which there is not some machine or other available. We seem, in fact, to have reached a wonderful stage of perfection in the development of automatic labour-saving appliances. It is not possible to do more than make brief mention of those exhibits which left an impression on one's mind, and among these were some of the modern core-making machines and moulders, one of the latter (of the pneumatic type) having squeezing and jarring actions in addition to a stripping movement. The manner in which the most commonplace actions of the workman may be reproduced in machinery is almost uncannily illustrated by the sand-slinger moulding apparatus, which faithfully imitates the action of the moulder in throwing handfuls of sand into the mould. This machine runs along the foundry floor, digging into the sand meanwhile, while in a subsequent operation the sand is riddled, and undesirable substances are removed and collected separately. Indeed, it would seem that with the general introduction of machines which are almost human the old-time skilled moulder will soon disappear.

Analysis of Brass and Gunmetal

The writer, a metallurgical chemist, draws attention to the disadvantages associated with some of the methods which are used for determining the constituents of brass and gunmetal. A description is given of a method which the writer has introduced, and which, he claims, has the merit of being rapid as well as reliable.

NUMEROUS methods have been devised for rapidly determining the constituents of brass and gunmetal. Up to the present date no very accurate methods have been adopted for securing analytical results in a short space of time. The methods used are either long and tedious, or rapid and inaccurate. Unfortunately, most of the experimental and research work on this subject has been carried out on almost pure samples of the metal. To the practical brassfounder these results are of little value, as most of the metal is made from scrap, and almost invariably contains impurities in the form of iron, aluminium, etc.

The method worked out by Walters and Affelder provides a rapid means of analysing pure brass and gunmetal, but this method is not accurate when iron and aluminium are present. Lead is precipitated by means of ammonium persulphate, the solution being acidified with sulphuric acid before filtering off. This means that aluminium and iron hydrates are partly redissolved, and to get an accurate assay of these two constituents they require to be estimated in an independent sample. Any time saved by this means of precipitating the lead is more than compensated for by the number of minutes required to estimate iron and aluminium. From this it will be seen that in ordinary works practice the method holds no advantage over the others as far as rapidity is concerned.

Time-saving Methods

The older methods of separating the metals are much more rapid if properly applied. These consisted of first evaporating the alloy with nitric acid for separation of the tin, and then boiling down the large filtrate and evaporating with sulphuric acid for precipitation of the lead. The amount of time lost here is considerable, but it can be avoided by applying the estimations in the following manner.

Estimation of Lead

Weigh one gram of the brass or gunmetal borings into an evaporating basin and add a mixture of 10 c.c. nitric acid and 5 c.c. hydrochloric acid.

It will be found in practice that the mixed acids are much more effective in dissolving the alloy than using nitric acid first and then adding the hydrochloric acid.

The reason for this is that nitric acid precipitates tin as stannic oxide, which will not readily dissolve in hydrochloric acid in presence of the former acid. When the borings have dissolved, about 3 c.c. of concentrated sulphuric acid is added.

The latter acid may be added while the solution is still warm by using a pipette, and allowing the acid to run cautiously down the side of the basin, keeping a clock glass on top as far as possible.

As a general rule the sulphuric acid can be added in this manner without any violent action taking place, as it usually flows to the bottom of the basin.

On shaking the basin gently to and fro violent action occurs with evolution of nitric oxides, hydrochloric acid, etc. If a large sized basin and good-fitting cover are used there will not be much risk of any of the solution being lost.

As the bulk of the liquor is very small it may be evaporated in a few minutes. After cooling, the solution is diluted, boiled, filtered and washed in the usual manner.

Since a small percentage of stannic oxide is often found in the lead sulphate, it would not be accurate to ignite and weigh the precipitate, more reliable results being secured by applying the molybdate titration.

The wet precipitate and paper are placed in a beaker and a little ammonium hydrate added. After shaking the precipitate off the paper as far as possible, glacial acetic acid is added. The precipitate should dissolve at once if the correct conditions have been adhered to. The solution is then boiled and titrated hot with a standard solution of ammonium molybdate.

This method of adding ammonium hydrate and then acetic acid will be found to be very much more rapid than digesting the precipitate in ammonium acetate, particularly when dealing with alloys rich in lead, such as ash metal. When dealing with alloys rich in tin, the lead precipitate usually contains stannic oxide, and is not always so rapidly soluble in the ammonium acetate.

Copper

An aliquot portion of the filtrate is measured off and the copper estimated by titration with thiosulphate.

No detrimental effects should be caused by the presence of tin salts.

To the remainder of filtrate an excess of sodium thiosulphate solution is added, and the liquor boiled. The sulphuretted hydrogen produced by the decomposition of the thiosulphate precipitates the copper and tin.

Tin could be estimated here by digesting the precipitate in nitric acid, but so much sulphur separates out that the estimation takes long to perform, also better results are secured by determining this metal in a separate sample.

Zinc, Iron, and Aluminium

Ammonia and ammonium phosphate are added to the oxidised filtrate, together with a little ammonium chloride.

After removing the excess of ammonia with dilute hydrochloric acid the solution is well stirred and settled. It is then filtered, washed, dried, ignited, and weighed.

This residue of zinc pyrophosphate contains any small quantity of iron or aluminium which has been present in the alloy. These metals are rapidly tested for, the residue being dissolved in warm hydrochloric acid and divided into equal portions. Aluminium is tested by the thiosulphate method, and iron by the thiocyanate colorimetric assay.

This method of working is much more rapid than precipitating the two metals with ammonium hydrate, weighing, and then testing the residue for iron. If no precipitate appears on addition of the thiosulphate it is necessary to filter the solution, whereas in adding ammonia the solution requires to be filtered and the precipitate may only consist of ferric hydrate. The weight of iron and aluminium oxide is subtracted from the weight of zinc pyrophosphate, which is then calculated to metallic zinc.

While the foregoing analysis is being conducted another sample of the borings is repeatedly evaporated with nitric acid, until the stannic oxide is free from iron salts, then filtered off, ignited and weighed. This estimation is completed while the zinc is being determined.

It will be found in practice that the method of precipitating iron and zinc together, and then testing the iron with thiocyanate, is much more rapid than precipitating iron and zinc independently. The titrations of lead by molybdate and copper by thiosulphate are carried out simultaneously.

On the whole this method of conducting the analysis is much more rapid, and it is, in the writer's opinion, as reliable for accuracy as the methods given in published text-books on the subject.

C. C. D.

Courses for Metallurgical Plant Managers

PROFESSOR R. S. MCCAFFERY has instituted in the University of Wisconsin a remarkable course in the metallurgical department for the benefit of university graduates holding responsible positions in industry. Many of the students are managers in works or hold similar positions, and they meet together on Friday evenings for lectures on thermodynamics and kinetics of chemical reactions, and on the physical chemistry of the metals. A discussion follows in which problems suggested in the lectures are discussed not in a competitive business spirit, but in the true scientific manner of men endeavouring to elucidate a common problem. In this way those attending the course keep in touch with the general and theoretical basis of their work, and the success which has attended the experiment indicates that such a plan meets a real want.

The Onset of Corrosion in Metals

Iron Compared with Non-Ferrous Metals

THE first (Experimental) Report to the Atmospheric Corrosion Research Committee (of the British Non-Ferrous Metals Research Association) has just been issued as a pamphlet by the Faraday Society (price 7s. 6d. net), and contains a large amount of valuable information concerning the onset of corrosion, not only in non-ferrous metals but in iron also. Mr. W. H. J. Vernon, B.Sc., in the summary of the report, which appears as a preface, points out that up to the present research has proceeded mainly along two lines, as follows :—

(1) "Field Tests"—i.e., tests carried out with relatively large specimens exposed to representative atmospheres, with the primary objects of (*a*) comparing the effects of these atmospheres upon typical metals and alloys, and (*b*) correlating the behaviour, among themselves, of as wide a range of materials as possible.

(2) The laboratory experiments conducted upon relatively small specimens, with the object, more especially, of obtaining information concerning the mechanism of atmospheric corrosion.

The report is accordingly divided into two parts, devoted respectively to these main branches of the work. Although much the greater amount of time has been expended in the former direction, actually the results so obtained have contributed largely to the object envisaged by the latter; for this reason the distinction between the two parts has not been retained in summarising the results. It should be stated that in consequence of the comparatively early stage which it represents, the present report is occupied, in the main, only with the phenomenon of tarnishing, as distinct from corrosion in the ordinary sense.

Conditions of Tests

The types of atmosphere investigated were (1) An indoor atmosphere maintained continuously in the unsaturated condition with respect to water vapour, (2) an indoor atmosphere of variable (but relatively high) humidity, occasionally reaching saturation, (3) an ordinary domestic kitchen, and (4) open-air exposure (at South Kensington).

The methods of examining and estimating tarnish films were —(1) visual. (Ordinary visual examination has also been supplemented, as occasion has required, by the use of the microscope.) (2) Optical. (After suitable preparation, the reflectivities of metal surfaces have been determined, (*a*) in the freshly cleaned condition, (*b*) during the course of exposure. The loss of reflectivity affords a very sensitive means of estimating the changes taking place at the surface, applicable more particularly to the earlier stages of tarnishing), and (3) gravimetric. (Accurate determinations have been made of the increase in weight of the test-plates, at intervals during the whole period of indoor exposure, and also in the very early stages of open-air exposure. In the case of indoor conditions, interesting relationships have been found to obtain between weight-increment and period of exposure.)

Rate of Increase of Weight

The significance of the shape of the curve obtained by plotting weight-increment against time is discussed in relation to the function of the corrosion product or "scale," and the principle involved appears to be of much importance. Three types of curve have been distinguished, and these, together with the interpretation to be placed upon them, may be indicated as follows :—

(1) A parabola whose axis coincides with the time-axis of co-ordinates. Weight-increment is thus proportional to the square root of time—i.e., the rate of attack is retarded as the period of exposure increases. The scale forms a continuous envelope, the rate of diffusion of the corroding atmosphere through which regulates the attack upon the underlying metal. An example of this is copper, within a wide range of humidity conditions.

(2) A straight line passing through the origin. Weight-increment is directly proportional to time—i.e., the rate of attack remains constant as the period of exposure increases. The scale is completely permeable, allowing free access of atmosphere to the metal, and itself playing a neutral part. Zinc, in an unsaturated atmosphere, is an example.

(3) A parabola whose axis coincides with the weight-axis of co-ordinates. Weight-increment is proportional to the square of time—i.e., the rate of attack is accelerated as the period of exposure increases. The scale is discontinuous, and accelerates the attack upon the remaining metal in proportion to the amount which is already present. The best example is iron in an atmosphere of relatively high humidity, intermittently reaching saturation.

Influence of Surface Condition

Whilst no appreciable difference has usually been observed by ordinary visual examination between the behaviour of emeried and brightly polished surfaces respectively, the optical and gravimetric methods have shown under certain conditions a greater degree of tarnishing on the rougher surface. Under "inside" conditions the maximum differences have been observed in the atmosphere of low relative humidity. In the more humid atmosphere, "dull" and "bright" surfaces have given practically identical results (both as regards weight-increment and percentage loss of reflectivity).

Behaviour of Iron

The behaviour of iron, on exposure to the atmosphere, is shown to be fundamentally different from that of the non-ferrous metals, whether observed from the visual, optical, or gravimetric standpoint. Thus, (1) whereas the tarnish on copper is perfectly continuous in the earliest stages, the rust which forms upon iron is discontinuous, occurring in isolated spots over the surface, which increase subsequently in number and size. (2) Iron exposed in indoor atmospheres loses reflectivity less rapidly than copper or zinc during such a period as it is increasing in weight to a considerably greater extent. (3) The weight-increment curve for iron in an unsaturated atmosphere appears to be a straight line; in a more humid atmosphere, however, intermittently reaching saturation, a parabola obtains of a type quite different from that yielded by copper. Thus, the axis of the curve is now the weight-axis (instead of the time-axis) of co-ordinates, indicating that the rate of rusting accelerates with increasing period of exposure, the weight-increment being proportional to the square of the time.

Even under straight-line conditions the rate of corrosion is excessively greater for iron; under the conditions represented by the above type of curve, however, it is evident that the difference after an appreciable time must become relatively enormous. After 336 days' exposure in a humid atmosphere the weight-increment of iron was thirty-two times greater than the weight-increment of zinc, the iron specimen then being completely covered with rust. On complete exposure to the open air a similar degree of disparity may be reached in several days. The reflectivity of a polished iron surface, in the presence of rain, is lost with extreme rapidity, in striking contrast with the non-ferrous metals where a measurable reflectivity is retained, even after much rain, for comparatively lengthy periods.

Reduction of Metallic Oxides

IT is obviously easier to discuss possible improvements in the metallurgy of any metal if the fundamental principles are known. In order to improve the metallurgy of zinc by distillation it is necessary to know a great deal more about the equilibrium diagrams involving zinc metal, zinc oxide, carbon, carbon dioxide and carbon monoxide. Some work has already been done along this line by the U.S.A. Bureau of Mines. After the work on zinc is complete, probably more will be undertaken on iron oxides, and possibly on lead and copper oxides, and after that on the less commonly used metals. The reduction of aluminium and magnesium by the help of carbon will always be difficult until the fundamental physical chemistry underlying these reductions has been studied. This general work will be taken up by the Bureau of Mines and the particular phases given attention from time to time. It is hoped that ultimately a bulletin will be published giving all the work and discussing the whole subject, both from an experimental and from a historical standpoint. It is felt that such a bulletin should bring together all the fundamental information and figures on the more common metals.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Standardisation in Blast Furnace Burthens

APART from the introduction of ferrous alloys, the metallurgy of iron and steel has not, for many years past, shown us any new thing. No invention commensurate with the introduction of the hot blast, or the Bessemer process, or the open-hearth furnace, has occurred of recent years. Nor is any new thing of any importance foreshadowed. Improvements come by greater attention to detail; not by the invention of any new process, but by modifications in practice. The crying needs of the industry are fuel economy and greater efficiency. Not to alter the blast-furnace design, but to improve and increase the output of those we have, is the object. One way remains, still in large measure untried. It is to standardise the burthen; to charge ores of uniform size, physical and chemical character, and moisture. By feeding a uniform burthen to the blast furnace the working is rendered so steady, uniform, and dependable that by such means alone the maximum efficiency can be secured, to the saving of much fuel and the manifest improvement of the product. Wherever this has been tried it has been found to justify the cost and to yield satisfactory and economic results. Very few details are, however, to hand.

An Alloy Age

ALREADY, as Sir Robert Hadfield says, we are passing from the age of iron and simple steel to the age of alloys. In the Middle Ages science sought to obtain the elements in their highest possible degree of purity. It did not succeed, and had it done so it is more than probable that the result would have proved worthless. Purity does not appear to be desirable in material substances. When the pure "active substance" of a drug is obtained a very inferior "drug" results. The natural product is to be preferred to the artificial; the artificial is too pure, and it is the associated impurities that appear to impart the real values to the substances in which they occur. Natural indigo is a much better dye than the artificial product. In metallurgy the intrinsic value of the associated impurity is wonderful. It is true that in some instances a very pure metal is found to possess very valuable properties. Armco iron is an example. On the other hand, another very pure form of iron, electrolytic iron, has special and useful properties. In general, however, pure metals are insipid. To bring out really striking properties, extraordinary tensile strength or hardness, resistance to corrosion, special magnetic properties, etc., it is necessary to add to the iron some other substance or substances. Often it becomes necessary to put back something of which the metal has, in the earlier or pig stage, been deprived. Thus we add carbon, and sometimes silicon or manganese. It is, indeed, an age of alloys; of chromium and nickel steels, of tungsten, and silicon and molybdenum. Copper in steel is said to increase resistance to chromium, but the possibilities of copper steels have been hardly explored. Aluminium and copper make a whole series of alloys of extreme interest, beauty, and value. Of the abundant minerals, clay and sand have in turn yielded up their treasures. There remains limestone, perhaps the most abundant of all. But as yet mankind has found little use for calcium.

Standard Steel Samples

THE chemical analysis of steel, while of vital importance in the manufacture and testing of steel, is a matter of considerable difficulty. Different chemists, using the same analytical methods on a variety of materials, or using different methods on similar materials, at times obtain discordant results. To overcome such difficulties, a demand has arisen for accurately standardised samples of steel by means of which analytical methods can be checked, mainly by chemists working in industrial laboratories and for commercial reference purposes. It is essential for such samples to be thoroughly homogeneous and to have attached to them analytical values of agreed accuracy. The preparation and issue of a series of such standards have been undertaken jointly by a Committee of the Iron and Steel Institute and the National Physical Laboratory. This involves a large amount of careful organisation and accurate laboratory work, in which the National Physical Laboratory are collaborating with a large number of chemists in works and University laboratories throughout the country.

In order to secure such collaboration, committees known as "District Authorities" have been constituted in London, Sheffield, Middlesbrough, Birmingham, Glasgow, and South Wales. Each District Authority consists of representatives of the local University or equivalent institution and of the works or commercial laboratories of the district.

The district authorities secure the co-operation of local steel makers and obtain from them ingots, billets or bars of suitable composition and adequate uniformity. To ensure that it shall be satisfactory, any material offered is first examined for correctness of composition and uniformity by a large series of analyses carried out in the first place by the chemist of the steel maker who has prepared the ingot and subsequently by analysts representing the district authority. A further check is applied by the National Physical Laboratory, and no material is accepted for standardisation unless the District Authority and the National Physical Laboratory are agreed as to its suitability.

Preparation of the Steel

As a rule, steel for standardisation is prepared in two-ton lots, and this, in the form of 6 in. bars, is sent to the National Physical Laboratory and cut into fine millings. Both the outer layers and the central portion of the bars are rejected and the remainder is cut up in a specially arranged milling machine under the close supervision of an expert chemist at the National Physical Laboratory.

The millings thus obtained, which are carefully protected from contamination, are next sieved and mixed, a quantity of about 500 lb. being manipulated at one time. They are then stored in air-tight steel tins which are externally painted a characteristic colour for each grade of standardised steel. Samples of these final millings are then sent out to all the district authorities, and final analyses for standardisation are made by the National Physical Laboratory and by analysts appointed by each authority. The results of all these analyses are collated, and if any discordant results are obtained the causes are carefully analysed. A final value for the standard is only accepted after substantial agreement between all the analysts has been obtained and a definite limit of possible error can be stated. Final acceptance of a standard rests jointly with the Committee of the Iron and Steel Institute and the National Physical Laboratory.

When the issue of a standard has been authorised, 50 gramme lots of the millings are weighed off and sealed in special bottles. Each sample of steel is standardised for one element only, and a certificate of the standardised value is issued with the samples.

The preparation of standards by such methods occupies a considerable time, so that up to the present only a limited range of British Standardised Steel samples are available. The following is a list of those already issued:

No. 1. Sulphur (S=0·027 per cent.).
No. 2. Sulphur (S=0·071 per cent.).
No. 3. Phosphorus (P=0·029 per cent.).
No. 5. Carbon (C=0·65 per cent.) Acid O–H Steel.
No. 6. Carbon (C=0·10 per cent.) Basic O–H Steel.
Cast Iron. Si=2·22 per cent., P=1·14 per cent., Mn=0·50 per cent.
No. 11. Manganese (Mn=0·69 per cent.) Acid O–H. Steel.

These samples are issued for sale by the National Physical Laboratory direct, and can also be obtained through the district authorities and through regular dealers in chemical laboratory supplies.

Other Standards

IN addition to these standards Ridsdale and Co., of Middlesbrough, issue a large number of similar steels and cast irons, which have been checked by a number of independent analysts. The latest list issued by this firm contains twenty samples, and the addition of a new carbon steel has just been announced. The majority of the steels in the list are carbon steels of various

types, and in one case the percentage of all the constituent elements is guaranteed, while in every case the percentage of the elements present in the greatest proportion is standardised. In addition to the various carbon steels there are nickel steels, chrome vanadium alloy steels, cast irons, and one standard basic slag. The prices vary from 15s. 6d. to 29s. 6d. per 50 grammes, with a reduction for greater quantities. In order that these standards should be used to the best advantage particulars are given with each as to the results of each of the co-operating analysts so that any variations may be detected, and in addition the methods used to determine the percentages are indicated.

Autumn Meeting Arrangements

ARRANGEMENTS have now been made for the Autumn meeting of the Institute of Metals which, thanks to the invitation of the members resident in the London District (who have constituted a Reception Committee presided over by Sir John Dewrance), will take place in London from Monday to Thursday, September 8–11 inclusive. It is hoped, especially as the meeting is to be held during the period of the British Empire Exhibition, that it will attract a large number of members, including many from overseas.

According to the preliminary programme which has been issued, members will assemble in London on Monday, September 8, and in the evening the 3rd Annual Autumn Lecture will be delivered in the Hall of the Institution of Mechanical Engineers—which has been placed at the disposal of the Institute for the whole period of the meeting—by Mr. W. M. Corse, S.B., of the National Research Council, Washington, D.C., U.S.A., who is the Honorary Corresponding Member to the Council for the United States.

On Tuesday, September 9, the morning will be devoted to the reading and discussion of papers. Afterwards members and their ladies will be entertained to luncheon by the Reception Committee at the Connaught Rooms, Kingsway. The afternoon and evening will be spent at the British Empire Exhibition, Wembley, where facilities will be afforded for inspecting some of the most notable metallurgical exhibits, including that of the Non-Ferrous Metal Trades Joint Exhibit Committee, with which the Institute is associated on the scientific side.

In the morning of Wednesday, September 10, further papers will be presented for discussion, the afternoon being devoted to visits to works or other places of interest. A Reception will be held in the evening at the National Physical Laboratory, Teddington, by invitation of the Director. For Thursday, September 11, an excursion is being arranged; alternatively members can spend the day at Wembley.

Application has been made to the railway companies for the issue to members proceeding to London from places more than twenty miles distant of tickets at the rate of a single fare and one-third for the return journey, upon production of a voucher at the time of booking. These tickets are expected to be available also for the period of the Iron and Steel Institute Meeting, to be held in London in the week following the meeting of the Institute of Metals.

The Metallurgy of Nickel

In the series of monographs on the mineral resources of the world issued by the Imperial Institute, the one by Mr. W. G. Rumbold (John Murray 5s.), dealing with "Nickel Ores," is worthy of notice as it contains an introductory chapter of some 25 pages summarising the history, metallurgy and uses of nickel. The main portion of the book describes the various deposits of nickel ores throughout the world, so that this introduction adds considerably to the value of the book by showing the subject in its true perspective. Nickel, it should be remembered, was a comparatively rare metal as late as 1890. With the discovery of new deposits the alloys of nickel, particularly with steel, have been found to have special properties which make them particularly useful in many directions. In addition, electroplating with nickel is now commonplace, and is used in numbers of everyday articles. Special interest attaches to the separation of pure nickel from its ores, as these usually contain high proportions of iron or copper, which, though it is no objection where alloys are required, leads to difficulties when the metal is wanted in a pure state for electrical or chemical uses. The method used in the Mond process is unique in metallurgy, and as is well-known this is based on the peculiar property that metallic nickel possesses of combining chemically with carbon monoxide to form a volatile compound known as nickel carbonyl, which may be distilled off and later decomposed to re-form its constituents in a pure state. This is not the only means of obtaining pure nickel—electrolytic and fusion processes are largely used—but it is in many ways the most interesting, and it is certainly one of the triumphs of chemical industry that this has become industrially practicable.

Ferro-titanium

NOT many years ago there were few uses for titanium minerals and products, but since 1900 the use of ferro-alloys containing titanium has decidedly increased and a considerable number of patents relating to the production of such alloys have been issued. Mr. J. W. Marden, in Bulletin 212, recently issued by the U.S. Department of the Interior through the Bureau of Mines, deals with the increasing use of this element, which has resulted from the general recognition of its efficiency as a purifying agent in the manufacture of steel. Metallic titanium has properties that restrict its use. It is white, but cannot readily be forged; it burns in oxygen to the oxide, and reacts directly with nitrogen. The element is fairly widely distributed, variable quantities of titanium occuring in granite, gneiss, mica slate, syenite rocks, and sometimes in granular limestone and dolomite, as well as in magnetite, hematite, monazite, zirconium ores, and auriferous sands. Ilmenite is also often present in deposits of magnetite. In recent years the commercial importance of titanium has increased and methods for its detection and analysis have, therefore, been developed.

The most important use of titanium has been in making the alloy, ferro-titanium, which is employed chiefly as a deoxidiser of iron and steel. Paints for protective coatings on iron and steel are made by mixing 10 to 15 per cent. asphalt with rutile and thinning with turpentine. Titanium compounds are also of value in the dyeing industry; alkali titanium salts of organic acids, such as potassium titanium oxalate, are used as mordants, and under some conditions give better results than aluminium salts. Titanous chloride or sulphate is used for bleaching silk and wool and titanium dioxide has been used as a catalytic agent in the esterfication of acetic acid. The use of titanium dioxide as a pigment in ceramic glazes probably consumes much of the oxide.

Analyses for Titanium

METHODS of analysis for titanium must be general enough to apply to the many sets of conditions that may be encountered in (1) ores such as magnetite, hematite, rutile, ilmenite, granitic rocks, auriferous sands, clays, etc.; (2) furnace slags; and (3) ferro-alloys which may contain many other elements than iron and titanium. Most of these compounds are insoluble in acids, and there seems to be much divergence of opinion as to the best fusion mixture for getting the substance into solution. At present there are about 12 methods for the separation and estimation of titanium. The Bureau of Mines believed that it would render the industries a service by collecting, abstracting, and discussing these methods, and calling attention to those that give rapid, accurate results, thus aiding the analyst who does not have time to review current literature carefully or to test new methods for himself. At present, methods are in demand for the determination of titanium in the presence of other elements without long and tedious separations. A number of methods of analysis for titanium, which have been thoroughly tested, may be obtained from the Superintendent of Documents, Washington, D.C., at a price of 40 cents, plus postage.

An Improved Steel for Shipbuilding

MR. F. G. MARTIN, chief chemist and metallurgist of Messrs. Alfred Holt and Co., Liverpool, states regarding his invention of improved mild steel, the new steel has a much higher elastic limit than that now used in the construction of ships, with the result that plates may be thinner without reducing their strength, thus rendering it possible for a ship of a given size to be lighter, and also for its spare horsepower to be used for moving a heavier cargo. Mr. Martin says his experiments dated from 1916, when one of Messrs. Holt's big passenger ships (the *Æneas*) went ashore.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

THERE is nothing encouraging to report about the iron and steel trade in June. The sluggish condition which prevailed during May has continued; indeed little else was to be expected, in view of the holiday season which Whitsuntide and the fine weather have ushered in. The quietness which usually characterises this season of the year is intensified. In some quarters it is reported that there is a better inquiry, but this can only be local and of no great importance. The accumulation of orders during the Whitsuntide stoppage was not large. Consumers are buying only what is necessary to meet urgent requirements.

What orders are about are largely in fulfilment of the railway contracts. These railway orders have been a godsend to the steel trade; without them many works would have found it impossible to keep going. As the Chairman of John Brown and Co. pointed out at the annual meeting of that company, the railway companies have shown great public spirit in placing their orders at home, when Continental material could be purchased much more cheaply. We should have liked to see more orders from the overseas railways, but they have been placed in the cheapest market. One Colonial order for locomotives has been placed with a German firm, who are seeking to obtain the plates in England!

Meanwhile the tale continues of works being closed down. The Redbourn Hill Steel Works are stopped. The Darwen and Mostyn Iron Co. are closing their Darwen iron works, which were restarted in 1922 after being stopped for 16 months. The Thornhill Iron and Steel Co. have closed down their iron works, as the losses of the past few years and the severe competition from the continent make it impossible for them to continue. Messrs. Alfred Hickman and Co. and the Kettering Iron Co. have each shut down a blast furnace.

Surprising Output Figures

With the iron and steel trade in this condition, a condition which has not come suddenly, but has been gradually approached, it is surprising to find that the output figures for the month of May are the third highest during the last 12 months. The weight of steel ingots and castings produced in that month was 809,700 tons, which compares with 638,600 tons in 1913. These figures serve to emphasise the point to which we referred in our last report, that the productive capacity of the country has been increased out of proportion to the prospective requirements, because even with this largely increased output there is still a considerable amount of plant standing idle.

The recently published accounts and reports of the three large concerns, The Ebbw Vale Coal, Iron and Steel Co., Guest, Keen and Nettlefolds, and John Brown and Co. are interesting reading. Although each is able to show good results, it is made clear that the profits earned are not from the steel-making side of the business. It is a fact that is worth repeating, that many of the large works have been kept running, not to make profits, but to pay wages and to prevent large numbers of men from being thrown out of employment. Very often the men do not realise this; if they did there would be a more helpful spirit shown towards the difficulties which the employers have to face. It is a fact, too, of which many consumers lose sight. Any small reduction in the price of fuel or raw materials is at once looked upon as a justification for lower prices of finished steel. This is a point of view which iron and steel manufacturers are strongly opposed to. Selling prices have long discounted these reductions, and any relief they afford should, for the present at all events, go to lighten the burden under which the manufacturers are struggling.

Activity in the Pig Iron Market

There has not been much activity in the pig iron market during the month. Producers have been anxious to sell, but the demand has been negligible, and the business done is in small lots. Prices are weak, but they offer no inducement to buyers, who apparently are expecting still lower prices. It seems inevitable that reductions will be made, notwithstanding the statement of the makers that even present prices are on the wrong side of costs. The new prices fixed for coke for the next three months will help the blast furnace owners. A new system has been introduced into these prices. Hitherto a flat rate has been quoted, but now the price is graded according to quality. This will probably be an improvement, as there has been a grievance for some time on account of the inferior cokes being the same price as the good brands. The working details of the scheme have not yet been settled, but the new prices mean a reduction of something like 2s. per ton. Owing to the falling off in the export trade coke supplies are now in excess of the immediate demand, and the new price arrangement will help the iron makers to select the coke which best suits their furnaces.

The bar iron trade is no better. Makers of marked bars continue busy, but for crown quality and common bars orders are scarce. The difference in price between small steel bars and iron is sufficient to overcome the advantages possessed by iron bars, and the preference is given to the cheaper steel.

Steel prices are nominally unchanged, but the scarcity of orders leads to the usual cutting of prices to secure the occasional good specifications that come into the market. Sections are quoted at £9 10s. and plates remain at £10 2s. 6d. to £10 5s. There is very little demand for heavy plates, but thin plates and sheets are still in good request, particularly galvanised sheets.

Steel billets are following the same course as the other branches. There is not much buying at present. There have been very heavy deliveries of Continental billets into the Midlands, but these are mostly against old contracts. Competition from the Continent seems to be getting more intense. Very low prices are being quoted by German and Belgian firms, although so far they have not brought out any appreciable orders.

Future German Competition

At present Belgium is the more active competitor, but there is an increasing weight of evidence that before long Germany will enter the field and become quite as formidable as she was before the war, if nor more so. An interesting report in this connection has been issued by the Department of Overseas Trade. Not only has the plant in Germany been renewed and brought up to date, but the highly developed commercial apparatus for marketing her products has been retained. She has excellent shipping facilities, and has kept in touch with consumers all over the world. With the relaxing of the tension between Germany and France, and the prospects of a general settling down of affairs in Europe, the future prospects are rather disturbing. The report points out that "any arrangement which is subscribed to which neglects to impose on the German industry obligations as heavy as those which bear on the home industries cannot fail to have the severest consequences. The inequality of the burden would be disastrous to our competitive capacity."

The Value of Optimism

Taking all things into consideration, the prospects of the immediate future are not at all cheerful, but it is no use being pessimistic. It is just in such times as these that a spirit of optimism should be cultivated. That may be the thought which has prompted Mr. Lloyd George and Sir George Paish to make such definite statements a few days ago. Sir George, speaking at Glasgow, said that we were within sight of the greatest expansion of trade the world has ever seen. His advice to shipowners with ships lying idle was, "Don't sell your ships; buy new ones." Let us hope that his prophecy becomes true.

The agreement between the coalowners and the miners is a good feature. It ensures peace in the coal fields for 12 months. The men have received liberal terms, better than some of the collieries can really afford. However, the industry can now settle down to the business of coal getting. The example might well be followed by those branches of the steel trade, in which demands for increased wages are still being discussed. It is essential that there should be a settlement of these matters. Given this, and a spirit of confidence, we may well look forward to the prosperity which the steel makers are so anxiously expecting.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Iron Manufacture

APPLICATION has been made by E. L. Ford of Youngstown, Ohio, U.S.A., for a patent for a process for purifying and refining iron. The puddle bath is treated with iron oxides of which the oxygen content has been artificially reduced, *e.g.*, by passing hot blast furnace gas or hot producer gas over them ; or by treating the oxides with powdered coal, or by oxidising finely divided iron or steel borings or turnings, or mixing them with iron oxide and treating the mixture. Finely divided carbon may also be added to the puddle bath. See application No. 214,205, having the International Convention date April 9, 1923.

Ferro-Chromium and Other Alloys

APPLICATION has been made by H. G. Flodin of Roslags-Näsby, Sweden, and E. Nobel of Stockholm, for a patent for obtaining metals and alloys low in carbon, *e.g.*, ferro-chromium. The ore is finely divided and briquetted with such a proportion of a carbonaceous reducing agent that the whole of the carbon is used in the reduction. Some of the reducing agent may be in the form of molasses, sulphite lye, or tar. The briquettes are lighter than the slag produced, so that the reduction takes place at the surface. The reduction is effected in an electric furnace, and the gases escape upwards through the incoming material to preheat it. See application No. 214,655, having the International Convention date April 20, 1923.

Non-Oxidising Alloys

AN alloy which is suitable for casting articles required to withstand high temperatures, such as annealing boxes, furnace structures, etc., and for electric resistance purposes, has been patented by the British Thomson-Houston Co., Ltd., of London (communicated by the General Electric Co., Schenectady, N.Y., U.S.A.). The alloy consists of iron containing 25–40 per cent. of nickel, 7–9 per cent. of aluminium, and 7–15 per cent. of chromium. The physical characteristics of the alloy may be improved by adding about 1 per cent. of titanium or manganese or both, but the whole of this addition may not remain in the alloy, but may go off with the slag. The alloy is readily cast and is very tough and may be machined, forged, rolled, or drawn into wire. It is only slightly oxidised by prolonged heating above 1,000° C. The base of the alloy may be of steel containing 0·02 per cent. of carbon, 0·04 per cent. of sulphur, 0·03 per cent. of phosphorus, and 0·15 per cent. of silicon. The iron, nickel and chromium are melted in a furnace having a basic lining, and tapped on to the molten aluminium. The furnace slag should not come into contact with the alloy, which should be covered with a slag of cryolite or cryolite-lime mixture, in which aluminium oxide is soluble. The alloy should not be overheated and should be cast at the lowest temperature. The moulds should be filled with a non-oxidising gas and dusted with cryolite. See patent No. 216,389 dated July 27, 1923.

Ferrous Alloys

A PROCESS has been patented by C. Billington, of Stoke-on-Trent, for producing an alloy of iron and chromium which is non-corrodible in sea water, or under ordinary atmospheric conditions, and which may be cast and machined. Pig iron, preferably hematitic or Swedish, is melted in a reverberatory furnace, and the carbon content reduced to about 0.6 per cent. by the addition of iron oxides. The chromium is then added in the form of iron-chromium alloy in the proportion of 7–20 per cent., and before pouring, oxides are removed by the addition of manganese, aluminium, molybdenum, boron or vanadium. The castings have a high tensile strength, and may readily be machined. See Patent No. 216,766, dated September 29, 1923.

Treating Ores

APPLICATION has been made by H. G. Flodin of Roslags-Näsby, Sweden, and E. G. T. Gustafsson of Stockholm, for a patent for a dry process for obtaining zinc. Zinc ore and finely divided iron, such as spongy iron, pig iron or alloys, are briquetted with binders such as water glass or clay, and heated to volatilise the zinc, iron sulphide being left as a residue. If any oxides are present, carbon may be added to reduce them. Any lead, silver or copper is obtained as a matte. Instead of iron, a mixture of iron oxide and carbon may be added. If iron pyrites is present in the ore, it may be heated to 700° C. to expel part of the sulphur before treating as above. See application No. 215,004 having the International Convention date April 25, 1923.

Magnetic Separation

A MAGNETIC separator which effects a more complete separation of the material has been patented by P. C. Rushen, London (Tfom F. Krupp Akt.-Ges. Grusonwerk of Magdeburg, Buckau, Germany). The material is passed through two or more annular magnetic fields, one outside the other, which may increase in strength outwardly. The material is delivered through the outer fields to the innermost field, where the main separation takes place, and any material not separated passes again through the outer fields by centrifugal force, and is there subjected to further separation. See Patent No. 215,935, dated April 25, 1923.

Preparation of Super-Refractories

Sillimanite and its Related Minerals

AN investigation having for its purpose the production, by electric furnace methods, of materials of higher refractoriness than those commonly used in commercial practice is being conducted by the U.S.A. Bureau of Mines. Such refractories have been called super-refractories. The first material to be investigated is sillimanite. Two methods of preparing the material are being studied, namely (1) from a mixture of clay and aluminum oxide in the form of bauxite, diaspore, or alunite residue ; (2) from clay alone by removing the requisite amount of silica and the iron by melting with carbon in the electric furnace. The material thus produced in the electric furnace is then subjected to the methods of testing refractory materials and is fashioned into brick and other shapes and given both refractory and commercial tests. Encouraging progress has been made in this investigation. It is expected that the work on sillimanite will be completed during the present year and that another material will be taken up.

Cyanite and Andalusite

Cyanite, a mineral identical in chemical composition with andalusite and sillimanite, but differing in crystal form, has not yet been exploited to the same extent as andalusite, but has many interesting possibilities. Deposits believed to be of commercial importance are reported in Wyoming, and in Virginia. The latter deposit is being developed at present. The commercial possibilities of cyanite are not yet fully known. Like andalusite it inverts to sillimanite when heated to high temperatures, and possibly may be used to produce sillimanite for refractory purposes.

Andalusite is an aluminum silicate which, when fired at a very high temperature, changes its crystallographic properties and inverts to sillimanite. It has been known for some time that porcelain and chinaware bodies contained considerable quantities of a crystalline substance which when examined with the petrographic microscope was found to correspond in nearly all respects with the mineral silliminate. Ceramic research by the U.S. Bureau of Standards demonstrated that porcelain bodies containing very high percentages of this artificial sillimanite were very superior in many respects as they possessed great tensile strength, high di-electric properties, and low thermal expansion. Through research work by a commercial concern it was discovered that instead of producing sillimanite synthetically from clay and silica, it could be made by substituting andalusite in the mixture from which the porcelain was made.

With the value of andalusite firmly established it became necessary to locate a deposit from which a commercial tonnage of pure material could be obtained. After patient search a deposit was found which is supplying the commercial production of andalusite to-day.

All the above minerals are dealt with in Serial 2,587, " New uses of non-metallic minerals," which may be obtained from the Department of the Interior, Bureau of Mines, Washington, D.C., U.S.A.

Current Articles Worth Noting

We give below a brief index to current articles in the technical press dealing with metallurgical subjects.

ALLOYS.—The granulation hypothesis and the delta-gamma change in iron-carbon and iron-nickel alloys. N. T. Belaiew. *Trans. Amer. Soc. Steel Treating*, June, 1924, pp. 549–570. The author describes his own theory and explains the occurrence of granulation in alloys.

Non-ferrous alloys in marine engineering. With special reference to Admiralty gun metal, manganese brass and white metals. *Metal Ind. (Lond.)*, June 13, 1924, pp. 571–573, and June 20, 1924, pp. 594–598.

Light alloys of aluminium. Part I. W. Rosenhain and S. L. Archbutt. *Engineering*, June 6, 1924, pp. 750–752. Alloys of aluminium with copper, zinc and silicon.

CORROSION.—A paradox in corrosion. U. R. Evans. *Chem. Met. Eng.*, June 16, 1924, pp. 949–953. An electro-chemical explanation of the fact that corrosion is sometimes greatest where oxygen is excluded.

The graphitic softening of cast iron. J. W. Shipley and I. R. McHaffie. *J. Ind. Eng. Chem.*, June, 1924, pp. 573–575. A study of the mechanism of the corrosion which develops in graphitic cast iron.

The submerged corrosion of iron. Part I. W. G. Whitman and R. P. Russell, *J.S.C.I.*, June 27, 1924, pp. 193–196T. Discusses the facts which any valid theory of corrosion must explain.

IRON.—Progress made in the manufacture of pig-iron and in the construction of blast furnaces during the last twenty years. J. Estour. *La Technique Moderne*, May, 1924, pp. 309–319.

The direct production of iron. E. Fornander. *Chem. Met. Eng.*, June 2, 1924, pp. 864–868, and June 9, 1924, pp. 907–910. A critical review of the more important methods that have been used to produce wrought iron from the ore.

The formation of graphite in cast iron. L. Northcott. *Metal Ind. (Lond.)*, June 6, 1924, pp. 554–558. The effect of different annealing temperatures on the shape of the precipitated temper-carbon.

CASE-HARDENING.—Prevention of case-hardening by copper plating. J. C. McCullough and O. M. Reiff. *J. Ind. Eng. Chem.*, June, 1924, pp. 611–613. A method for selective case-hardening by the carbon-pack method.

ALUMINIUM.—THE influence of silicon and iron on the properties of aluminium. J. Czochralski. *Z. Metallkunde*, May, 1924, pp. 162–173 (in German).

The development of the aluminium industry in Germany. H. Specketer. *Z. angew. Chem.*, June 25, 1924, pp. 447–451 (in German). A description of the works producing aluminium.

ANALYSIS.—Ascarite, an absorbent used in the determination of carbon in steel by the direct combustion method. J. B. Stetser. *J.S.C.I.*, June 20, 1924, pp. 637–638.

The present status of magnetic analysis. R. L. Sanford. *Trans. Amer. Soc. Steel Treating*, June, 1924, pp. 577–589. Discusses advantages and disadvantages of the magnetic analysis of materials and makes reference to the types of testing equipment employed. A bibliography for the years 1914–1924 is appended.

Rapid method for the estimation of silicon in steels. J. Vernay. *Chim. et Ind.*, May, 1924, pp. 886-888 (in French). Uses a phospho-sulphuric acid mixture for the decomposition of the steel.

ELECTRO-DEPOSITION.—The repair of worn components by electro-deposition. J. P. McLare. *Metal Ind. (Lond.)*, May 30, 1924, pp. 521–524 and p. 532.

ZINC.—The mechanism of the metallurgical production of zinc. M. Bodenstein. *Z. angew. Chem.*, June 25, 1924, pp. 439–445 (in German). Explanation of the process of reduction of zinc ores.

SILVER.—The tarnishing and detarnishing of silver. Part IV. G. W. Vinal and G. N. Schramm. *Metal Ind. (N. York)*, June, 1924, pp. 231–233. Causes of tarnishing and comparison of methods of removal.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act, of 1908, provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

BIRKS (S. F.) (SHEFFIELD), LTD., iron and steel manufacturers. Registered May 31, £750 mortgage and £750 2nd charge, to G. Yeomans, 2, Royds Mill Street, Sheffield, haulage contractor, and H. Wells-Smith, Figtree Lane, Sheffield, C.A.; charged on Favorite Steel Works, Edward Street, Sheffield.

BLUNT AND WRAY, LTD., London, N.W., metal manufacturers. Registered June 4, mortgage, to bank; charged on 70, Salusbury Road, Willesden. *£8,000. February 22, 1924.

BOLTON MOOR FOUNDRY CO., LTD. Registered June 10, £800 debentures (filed under section 93 (3) of the Companies (Consolidation) Act, 1908), present issue £750; general charge. *Nil. April 25, 1924.

COOK (JOSEPH), SONS AND CO., LTD., Washington, iron manufacturers. Registered May 30, £3,300 debentures part of £20,000; charged on lands and buildings at Washington; also general charge (except heritaments charged under deed dated March 11, 1916). *£25,[illegible]. July 16, 1923.

FORSHAW (E.) AND SON, LTD., Warrington, ironfounders. Registered June 4, £3,000 2nd debenture; general charge. *£3,200 mortgage, £9,800 debentures. August 14, 1923.

MONK BRIDGE IRON AND STEEL CO., LTD., Leeds. Registered May 26, mortgage and charge, to bank, charged on Monk Bridge Iron Works, Whitehall Road, and land in Gelderd Road, Leeds; also general charge. *Nil. June 11, 1923.

MURRELL (WM.) AND CO., LTD., London, S.E., ironfounders. Registered May 28. Land Registry charge (securing £1,000 debentures issued by company on September 1, 1923), to C. W. Smallbone, The Hollies, Chobham; charged on 237, Walworth Road and foundry at rear. *Nil. December 31, 1922.

NORTH WALES IRON AND MANGANESE CO., LTD., Liverpool. Registered May 30, £10,000 debentures (filed under section 93 (3) of the Companies (Consolidation) Act, 1908), present issue £4,540; general charge. *Nil. December 31, 1923.

SMITH AND COVENTRY, LTD., Salford, ironfounders. Registered June 11, £1,000 debentures, part of £25,000; charged on properties at Salford; also general charge. *£115,000 debentures. October 31, 1923.

London Gazette

Companies Winding Up Voluntarily

BRITISH METALLURGICAL CO., LTD.—F. E. B. Green, 4, London Wall Buildings, E.C.2, appointed liquidator.

NATIONAL ALLOYS, LTD.—Liquidator: W. Lambert, Dock House, Billiter Street, E.C.3.

Supplies of Non-Ferrous Metals

SIR RICHARD REDMAYNE, speaking on Tuesday at the World Power Conference at Wembley, pointed out that a much more pressing problem than the duration of the coal supply was the need for finding substitutes for certain of the non-ferrous metals, particularly lead, zinc, tin and copper, which would be exhausted long before coal at the present rate of production.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

World Power Conference

YET another conference in which the mining and metallurgical industries are greatly interested has been brought to a successful issue at Wembley. This is the World Power Conference, the rather misleading title of which may have somewhat masked its interest and vital importance to those engaged in the heavy industries. A very large number of excellent papers dealing with every aspect of power production were submitted, amongst which it is only possible to make brief reference here to those more especially devoted to the iron and steel trades. The paper by Mr. Barton Shover on power in the iron and steel industry in America contains a number of tables in which the power units required and the rated horse power are given for large groups of plants. After an exhaustive survey of the data available the author points out that in America the tendency is towards the electrification of all power-driven apparatus except blast furnace blowers, an exception which is met with in other countries as well where turbo-blowers and gas engines are universally preferred.

Naturally the largest and most important group of papers were those dealing with coal resources and the economic utilisations of fuel. Sir Richard Redmayne, in an able survey, dealt with the coal resources of the world, while Dr. Lander's paper constituted a more specialised survey of those of Great Britain. A paper somewhat obscurely related to power production, but containing much useful information relating to the production of electrolytic iron, was contributed by Mr. T. W. S. Hutchins, and metallurgical engineers will find much that is helpful and suggestive in the paper by Mr. K Rummell on blast-furnace gas economy in German ironworks.

Coal in Ireland

THE late Professor Grenville Cole, whose recent death all geologists and mineralogists sincerely deplore, was, with Mr. Lyburn, conjointly responsible for the account of Irish coal resources at the International Geological Congress of 1913. Those resources were estimated at 180,500,000 tons actual reserve, and 110,840,000 tons probable reserve. Of the latter 95,000 tons were ascribed to the Tyrone coal field, the largest coal field, that of Leinster, being credited 156,000,000 tons of coal classed as "actual reserve." Yet on Friday last the new collieries in the Coalisland section of the Tyrone field were successfully opened, and the estimates place the amount of available coal in this area alone at no less than 200,000,000 tons. The development of the new area is due to the foresight and perseverance of one man, Sir Samuel Kelly, and the whole story exemplifies once again the efficiency of private enterprise as against all possible rival schemes of a socialistic or communistic complexion in developing sources of mineral wealth. As ironstone is widely distributed in Ireland and blackband ores have been found in County Antrim it is not improbable that northern Ireland may yet become an iron and steel centre. No estimates exist as to the actual iron ore resources of the Coalisland area, but the geological conditions are such as to warrant the expectation that deposits of commercial value may yet be found in the not far distant locality. Hitherto Ireland has, from a mineral point of view, been chiefly identified with the possession of peat beds which have not been developed to the extent they deserve. A new era may be in sight for our latest Dominion.

Latter Day Alchemy

THE ultimate objects of the art and mystery of alchemy throughout the middle ages were the transmutation of the base metals into gold, and the discovery of the elixir of life. Both these objects have, if the daily Press is to be believed, been achieved recently, in Germany! Professor Miethe is credited with having obtained, in his laboratory at Charlottenburg—the Mecca of German science—appreciable amounts of gold from mercury by employing "powerful electric currents." Thus is the first of the two objects of alchemy attained! The solution of the second is along lines familiar to us all. It is exemplified by the cobbler when he confers immortality on a pair of boots by alternately soleing and heeling them, and subsequently providing new uppers, so that the boot persists despite the decay of its components. Similar processes have been known to serve for the resuscitation of clocks, watches and motor cars. According to Dr. Finkler the heads of certain insects can be grafted upon the bodies of other species, and—necessarily—*vice versa*. This vicarious immortality would seem to be a marked advance on mere rejuvenation by monkey glands. Unfortunately Drs. Blunck and Speyer cut at the very root of the new discovery by the simple method of denying the facts. So, too, is Professor Miethe's gold, blown upon by British and other scientists. Both discoveries, have, it would seem, been prematurely announced. Yet, whatever the Finkler experiments may be worth, the neo-metallurgist feels in his bones that Dr. Miethe may well be on the right track in regard to his extraction of gold from mercury.

The Transmutation of Metals

THE transmutation of metals is no new thing to present-day scientists. Of its possibility there remains not a shadow of doubt. Any metal, or indeed any element of given atomic number, is theoretically capable of being disintegrated into another metal or element of lower atomic number, the process being hitherto irreversible. No method has, as yet, been discovered of synthetic building up; only the pulling apart process has as yet yielded results. Between the laboratory process, however, and its economic and industrial applications there is a great gulf fixed. It is many years ago since Moissan proved the identity of certain forms of carbon present in iron and steel, with the diamond. Endeavours to make diamonds have yielded only insignificant results, costing far more than they are worth. The separation of gold from mercury at Charlottenburg, even if it has been actually accomplished, is no more than an interesting development along the lines shown to be possible by Rutherford and others. As a commercial proposition it is not likely to affect international exchanges.

Modern Open-Hearth Steel Works

A New Text Book on Their Planning, Erection and Operation

We publish below a review of an important new work by Hubert Hermanns on "The Planning, Erection and Operation of Modern Open-Hearth Steel Works," published by Ernest Benn, Ltd., pp. 308. 42s.

THE metallurgy of iron and steel dates back—if not to the days of Tubal Cain—at least to mediæval times, with sporadic instances of the more or less accidental manufacture of steely irons by methods dating even further back. It is, however, only within the recollection of that hardy specimen, the "oldest inhabitant," that real and substantial progress has been made in the industrial and economic production of steel in masses commensurate with the modern needs of mankind. The milestones on the road of discovery and invention are the introduction of the earliest converter, by Bessemer in 1855; the invention by Siemens of the regenerative furnace in 1857, followed by its adaptation to steel making in 1861; the pioneer inception, by Snelus, in 1872, of the basic process, and its successful development and perfection by Thomas and Gilchrist from 1879 to 1881; the invention of the first practicable electric steel furnace by Heroult in 1886, and the introduction, at Pencoyd, of intensive mass production by Talbot, by a "continuous" process, in 1899. Since that date there has been practically no new thing to record so far as the actual manufacture of ordinary steel is concerned, except the method of producing Armco iron, which is not steel, although produced by methods which were previously regarded as distinctive of the manufacture of steel as compared with that of iron.

No Revolutionary Process

In the opinion of the most competent judges, no very new or revolutionary process is now to be looked for in the ancient art. The field of invention has been thoroughly ploughed, nor have the last twenty-five years been productive of any new or radical discovery. Such progress as has been made has not involved fundamental principles; it has been in the direction of the constant improvement and development of the processes actually in vogue. The incentive to improvement is keen; labour is increasingly expensive; fuel is fast becoming a precious mineral, and its alternative, water power, is available only in countries physically endowed with such resources. Sun power, wind power, the tides and the primordial energy of atoms have not as yet been efficiently harnessed to the service of man. It is by the improvement of technique, by constant attention to economy and by minute and cumulative development of existing plant, processes and appliances that the steel industry of the world in general, and of this country above, possibly, all others, must depend for its future existence, let alone its prosperity.

Great Britain is the pioneer country in the metallurgy of steel. She was the first in the field, and for many years foremost. While this is a fact to be proud of, it constitutes unfortunately a handicap as well, Many British works, laid down in the early days of the steel trade, when labour was plentiful and coal was cheap, are old-fashioned and ill-suited to modern requirements. The work by Hubert Hermanns, the title of which is reproduced at the head of this article, is therefore one which should make a special and immediate appeal to British steel makers. It is the only thoroughly modern and up-to-date book of its kind. The literature of its subject is, it is true, voluminous, but it is scattered, and is, moreover, written in many languages. The English edition of Hermanns' work renders available to English readers a wealth of detail which could only be obtained by much laborious hunting through the files of the technical press of America, Great Britain, France, Belgium, Italy and Germany.

Profiting by British Work

Until the Great War shook to its very foundations the industries of the countries it involved, Germany occupied the second place as a great steel producing nation, the United States coming first, and our own country third. Both America and Germany reaped the advantages of British pioneer work; coming later into the field, they were able to profit hugely by the lessons learned in Great Britain. The ay-out of works, upon which so very much depends, was therefore more up-to-date and inevitably more efficient in those countries than at home. Our older works suffered by comparison and in competition, until the bolder of our steel makers faced the situation by remodelling and reconstructing their plants. We have now a number of works which can compare favourably with those abroad; we have still, however, a large number of ramshackle plants which excite surprise at their ability to keep their heads above water at all. America and Germany have learned a lot from British practice, and the time has come when we can with advantage learn a lot from them. Hermanns' volume, embodying all that is latest in regard to efficient lay-out and equipment, constitutes a compendium from which such lessons can be drawn.

As the author quite rightly says, "The auxiliaries of open-hearth working are of equal economic importance with the metallurgical processes; in great measure they not only render these latter possible, but assure the efficiency of the process." He is not concerned greatly, therefore, with the process itself, but with the technique of the appliances, and with the arrangements to be made to see that the process is carried out to the best advantage. A commendably brief introduction epitomises the history of the process, after which the gist of the metallurgical process itself is as briefly discussed. The section in which this is done forms an admirably terse and succinct account of the chemical and thermal reactions involved in standard practice with standard materials.

Relative Location of Steel Works

The location of the steel works in relation to other plant, and that of the individual departments, form the next two sections of the work. The subject is discussed under the heads of supply of raw material and of liquid iron; the provision of heat; the removal of the products and the situation of railway sidings; the storage requirements generally and the conditions which should prevail to facilitate operations in the steel foundry. It is obvious that these considerations cannot be standardised. In a new works ordinary principles of plain common sense will govern the lay-out, and given that adequate railway or canal facilities exist, or that the works are situated on a sea coast, or on the banks of a river, the natural sequence of operations will in themselves lead to the adoption of a plan or lay-out that will tend towards some kind of standardisation. The space available will often be a controlling factor, and the shape of the area on which the works are situated, the most important of all. In older works, of which in this country there are so many, often cramped for room, and not too favourably placed, it is not what the owners would like to do, or what the best practice would suggest, but what can be done, that will decide the plan to be adopted.

It is in such circumstances that the present sections of Hermanns' work will be valuable and suggestive, because they are accompanied by descriptions of many of the best laid out steel works of America, France, Germany and Belgium, and illustrated by plans, which in some instances although approaching the ideal, are actually possible at the works described. The engineer charged with the elaboration of new plans will find herein much that will be helpful.

Details of Equipment

It is, however, to the details of equipment, and rightly so, that the book is mainly devoted, and it is this feature which differentiates it from previous text books of its kind. It is far fuller, and more up-to-date. The reader will turn with interest to the sub-section in which the author deals with the modification of the design of furnaces and plant consequent on the use of coke oven gas, or of mixtures of coke oven gas and producer gas. At the same time some regret may be felt that neither details of the new 500 ton continuous Talbot furnace at Cargo Fleet, nor of Dyrssen's valuable paper on recovery of waste heat in open-hearth practice, read before the Iron and Steel Institute at the recent May

meeting, and the suggestive discussion to which it gave rise, were available to the author at the time the German edition was written. Doubtless it will be possible to incorporate in subsequent editions some of the lessons to be learned from the sources referred to.

Not many works in this country have as yet adopted coke oven gas for open-hearth working, and information as to the Cargo Fleet furnace is awaited with impatience. Mr. Talbot is perhaps the greatest expert in open-hearth furnace design in this or any other country, and his experience may be trusted to throw valuable light upon a problem now engaging steel manufacturers all over the world. Details of the practice at the Hoesch works in Germany and at other continental works, are given in this section, which also contains references to oil, tar and pulverised coal. In regard to the use of tar it will be remembered that the late Adolph Greiner read before the Iron and Steel Institute in 1915 an account of his experiences with this fuel at Seraing during the war. A very brief mention of these experiments is given by the author, but more detail might with advantage have been included.

Design of Regenerators

The design of regenerators and a discussion of their best location constitute questions upon which opinions are widely divided. The nature of the fuel used or available is the paramount consideration. With coke oven gas, the solution is simple : no gas regenerators are required and only the air need be heated. Probably regenerators placed as they are in the new Talbot process are as good as any for the purpose, particularly in fixed furnaces, where the sealing is simple. There is a growing volume of opinion that in some circumstances even producer gas regeneration might be found unnecessary. Work on the lines indicated recently by Siegle has clearly indicated a limit of usefulness for these adjuncts which tend to be uneconomical from a fuel point of view. This section of Hermanns' volume is well arranged and admirably illustrated, and only a trifling objection may be raised to the use throughout of the Americanism " block " when ports or port blocks are meant. The portion devoted to a discussion of the various designs of ports and of water cooling, and the details of furnace anchorage are very well done. The remaining chapters deal with the furnace accessories, producers, ladles and casting pit design, and the handling of the ladle, and of the slag. The vexed questions of top or bottom pouring, the nature and the influence of the mould, and the making of additions are not discussed, which is perhaps a pity. Apparently they are not regarded as being within the scope of the work. In the concluding sections the author deals with ways of improving thermal efficiency, and amongst these includes the installations of waste heat boilers. As it is to improved thermal efficiency that all endeavours are now directed, the criticism may again be made that this section might with advantage have been more detailed. The author contents himself with stating that in German practice little has been achieved in regard to waste heat boilers. An example of British practice in this direction is cited, and it is stated that American practice has made some progress, and that the waste heat boiler in that country has given entire satisfaction. This is not really enough, and much more information is actually available.

The last section deals with the duplex and triplex processes, and although brief presents a useful summary of present views.

The whole subject of open-hearth furnace practice is so vast, and the literature is so enormous, that it is perhaps a little unfair to grumble because the present work does not survey exhaustively the whole field. What is given is well and judiciously selected, and much labour must have been expended to collect within such convenient compass so much which is of value to the reader. The translation has been admirably carried out, the volume is well edited, the illustrations are excellent and the book is beautifully printed in a manner which reflects the greatest credit upon all concerned in its production. *Modern Open-hearth Steel Works* constitutes an indispensable addition to the metallurgical library, and metallurgists are under a very real obligation to the publishers for rendering it available to English-speaking workers.

Bricks from Blast Furnace Slag

[From a Correspondent.]

The neglect of scientific methods, and especially of the technical chemist, is now making itself felt in no uncertain fashion in at least two of our most important industries, coal mining and the manufacture of iron and steel. One of the most neglected sources of economy in the latter industry, which has been adopted years ago on the continent, is the conversion of the waste blast furnace slag, which exists to the extent of millions of tons, into high grade bricks, for which there is an almost unlimited demand.

The principle consists in mixing the slag in a roughly pulverised condition (or disintegrated by running the molten slag into cold water) with 6–10 per cent. of its weight of thoroughly slaked lime. The secret of success is to slake the lime in such a manner that no trace of unslaked lime (quicklime) is left, which is always the case with most ordinary methods of slaking, and from a chemical point of view it is extremely difficult to detect minute quantities of free lime in slaked lime. The necessity of complete slaked lime for this process was first realised by Sutcliffe, Speakman and Co., Ltd., of Leigh, Lancs, who have specialised in slag, ash, clinker, and sand bricks plant for many years and were one of the pioneers of the process.

Lime-Slaking Device

Accordingly a special form of hydrater is used for slaking the lime, the latter being first ground and then conveyed mechanically into two or more horizontal steam jacketed, cylindrical chambers, in the first of which are fitted pressure water sprays, the arrangement including powerful agitators so that the powdered lime is mixed with water and heated at the same time, being subsequently added to the right amount of fine slag. After a preliminary mixing the slaked lime and slag are then passed into a special type of edge-runner mill, having broad hard iron faced rollers weighing 6 tons each, so that an impalpable powder is formed, with no trace of unslaked lime remaining. The semi-dry mass is then discharged continuously into a brick moulding machine working at two tons pressure per square inch, and brick shapes so obtained are subsequently packed on small wagons, each containing 400 bricks, and passed into a long horizontal tunnel of bricks or concrete. Here they are subjected for 5–6 hours to steam at atmospheric pressure, that is a temperature of 212° F., the chief chemical reaction being a combination of the free silica (SiO_2) (or the acid silicates) of the blast furnace slag with the lime, forming calcium silicates, which bind the whole mass together and give intensely hard bricks, which are ready for use almost immediately they are pulled out. Bricks of this character are equal, if not superior, to the ordinary burnt clay product, and in this connection the British Standards Specification (No. 187) for the analagous sand-lime bricks should be consulted. The crushing strain is about 4,800 lbs. per square inch, and they have a very pleasing appearance, being grey in colour, and satisfactory in every way, millions of them having been used on the continent for years past. In general, scientific methods in brickmaking seem to be long overdue in Great Britain.

Production of Iron from Scrap

A co-operative agreement has been arranged between the British Columbia Bureau of Mines and the United States Department of the Interior whereby the North-west Experimental Station of the United States Bureau of Mines at Seattle, Washington, will assist the first-named organisation in establishing the best conditions for converting steel scrap, tinplate scrap and sponge iron concentrates into foundry iron and steel through the medium of the electric furnace. The expense of this investigation will be borne by the British Columbia Bureau of Mines. This work is a continuation of the laboratory work on synthetic iron previously done at Seattle by the Bureau of Mines. It is expected that the results will be applicable to the production of grey iron from sponge iron. The tests will include observations on the relation of charge to product, methods of controlling the composition of the product, power consumption, costs, etc. The furnace is of the Greene (Heroult type) three-phase, acid-lined, and of 3,000 lb. capacity.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Cast Iron Research Association Laboratories

A FURTHER stage in the development of the Cast Iron Research Association was reached a few days ago when the Association formally took possession of its own laboratories. These are situated in Guildford Street, Birmingham, and are equipped for the conduct of chemical analyses and general metallurgical and heat treatment work. The capacity of the Association to deal with its work will be greatly increased, but it is not intended to abandon the policy of having investigations conducted in prominent University laboratories and in the works members.

It is anticipated that the Association, which commenced a new financial year on July 1, will incur an expenditure during the year of between £6,000 and £7,000. The research programme includes important investigations on erosion and corrosion-resisting cast irons; moulding sands; graphitisation; heat-resisting cast iron; the production of malleable cast iron; cupola practice; cast irons for electrical and magnetic purposes; measurement of melting and pouring temperatures; the fundamental properties of cast iron; standardisation of test bars, materials and methods; facing sands and blackings, and cast iron to resist abrasive wear, and jointly with the British Motor and Allied Manufacturers' Research Association, automobile cylinders and pistons.

Recent new members include the Brightside Foundry and Engineering Co., Ltd., Sheffield; Powell Duffryn Steam Coal Co., Ltd., Glamorgan; Boving Engineering Works, Ltd., Stoke-on-Trent; J. Blakeborough and Sons, Ltd., Brighouse, Yorks; J. W. Jackman and Co., Ltd., Manchester, and Younger and Callon, Dunston-on-Tyne.

Fluxes and Slags

FLUXES and slags have this in common, that they are extraneous substances which play an important part in removing impurities from metals, when, by their nature, their melting points are akin to those of the impurities in question, when their action is of a "washing" nature or when they form compounds with the impurities sufficiently fusible to enable them to be eliminated more or less easily, either by gravity or by mechanical means. The literature of slags, which play an important part in purely metallurgical processes and operations, is plentiful, but scattered. That of fluxes, which are fusible substances used for special purposes at later stages of manufacture, chiefly for the purpose of preventing surface corrosion such as oxidisation, or removing such surface impurities, chiefly oxides, as have already formed, is, on the other hand, scanty and empirical. The Faraday Society has done good service to metallurgy by gathering together much valuable information on the subject of both fluxes and slags in metal melting and working, and at the recent conjoint meeting under the auspices of that Society, of the Institute of Metals, the British Non-Ferrous Research Association, and the Institute of British Foundrymen, a number of exceedingly useful papers were read and discussed.

Sulphur Removal by Carbon

THE functions of slag in the removal of sulphur are exceedingly important in the manufacture of copper, steel and other metals. For effective desulphurising a definite ratio should exist between the sulphur absorption capacity of the flux and that of the metal. This is given, in a paper by B. Bogitch, as 500 times greater for the flux than for the metal, in the case of iron, and as much as 2,000 times greater in the case of copper. With manganese it is less than with iron. These instances apply, of course, to molten metals, and the subject is complicated by the fact that the absorption coefficients for the metals are not accurately known. In solid metals mere heating in a closed chamber in the presence of carbon has a desulphurising effect on, for example, steel, but the action is erratic, irregular and difficult to control. On the other hand, more porous metals such as nickel and cobalt are much more rapidly acted upon in this way, and some interesting experiments are recorded in which the removal of even as little as 0·013 per cent. by this method led to very appreciable improvements in the mechanical properties of the metal. The experiments contain the germ of what might easily become a useful industrial process.

Fluxes in Secondary Operations

THE uses of fluxes in welding are, of course, well known, yet many useful hints may be gathered by those engaged in such operations from the papers by Messrs. Spraragen, Coulson-Smith and Ogden. The former deals with the subject from a generalised point of view, and the other two papers deal with oxy-acetylene welding and arc-welding respectively. A well-written paper by T. B. Crow summarises the use of fluxes for soft soldering, in which a useful distinction is made between the property of "welding" which is of course a function of surface tension, and "alloying" which in the workshop is often erroneously confused with the former. At the same time the first essential of a good soft solder is that it should form, by diffusion, an actual alloy between at least one of its constituents and the metal to be soldered. This condition seems, in some cases, to have an obscure relationship with the flux used. There would appear to be some special magic in zinc chloride. A hint that this is so is to be derived from Mr. Crow's paper, but in a paper by Dr. Bailey the point is more strongly emphasised. In the tin plate industry zinc chloride is freely used. He says "the zinc chloride would appear to have some specific action. . . . what that action is I am not prepared to say definitely."

The use of fluxes in the melting of brass is dealt with in a communication from the Research Department, Woolwich, by Genders and Haughton, and Dr. Rosenhain deals, with his customary lucidity and grasp, with the use of fluxes in the melting of aluminium and its alloys, an excellent paper in which Mr. Archbutt is his collaborator.

Oil Fuel in Blast Furnace Practice

THE use of oil fuel in blast furnaces is by way of being an entirely new thing. A blast furnace plant in Rumania has quite recently adopted this method of firing, with results that, after innumerable initial difficulties, have proved entirely satisfactory. The furnaces are of 150 tons capacity and local petroleum residues (mazout) are used. The mazout is pulverised by being blown from the tuyere boxes into the furnace, at comparatively low pressures. The nozzles are jacketed with pipes through which the blast, which serves as the air for combustion, is delivered. More exact details will be forthcoming shortly; in the meantime it may be said that approximately 15 per cent. of the coke charged with the burden is saved. As coke is exceedingly dear in Rumania, and mazout an almost valueless waste product, the economies effected by its use are, it may well be believed, considerable. Metallurgists will await with interest further particulars, as the injection of fuel at the tuyere makes a vast difference in the functioning of the furnace. Not only are the usual zonal reactions complicated, but the composition of the furnace gases is radically altered. The calorific value of the latter is said to be greatly improved.

New Feature in Cupola Practice

AMERICAN foundry practice has admittedly reached a very high standard of technical efficiency. The latest development is one which possesses noteworthy advantages. This is what is termed a "twin cupola," that is to say, two cupolas with a common hearth. The cupolas are 4½ ft. apart and between them is a rectangular hearth. Both cupolas are charged simultaneously, and the operations of blowing are the same for each, so that the rates of smelting are likewise the same in each cupola. The hearth, being fed from both, fills up quicker, and requires to be tapped oftener. Apart from the saving of space, which results from grouping the cupolas in pairs, the system has the further advantage in that the iron is very thoroughly mixed in the common hearth, and, as there is practically twice the amount of molten iron ready at a time for castings, a receiver can often be dispensed with. It would seem that the system, which has been found to work admirably, is susceptible of considerable expansion, as there appears

to be no reason why three or more such cupola stacks should not be grouped around a central hearth and thus fed at several times the rate that an ordinary cupola hearth can be filled. The foundry is so seldom the scene of any radically new development that the twin cupolas' behaviour will be watched with interest.

The Double Electric Furnace

AFTER the twin cupola, the twin electric furnace, which also hails from America, and is said to have been put into operation in Pittsburgh. The idea is as novel as it is ingenious. Two furnaces are mounted on a revolving platform, so arranged that either furnace can be worked by the same pair of electrodes. Each furnace can thus be charged, operated and tapped independently of the other, and as soon as one is ready to tap, the electrodes can be raised, the platform rotated, and the other furnace, which will have been charged previously, can be brought into position. The electrodes are now lowered and the operation of melting and refining recommenced. The saving in electrical equipment is obvious, but that is not all. Both time and floor space are saved, as the furnace not in actual operation can be repaired and fettled without loss of time. Nothing is said regarding electrode consumption, but there is no reason why this should exceed the normal consumption in working two charges, so if nothing be gained nothing need, on the other hand, be lost. Up to now the method has been tried with small furnaces of $1\frac{1}{2}$ to 3 tons capacity only. The suggestion has been made that the system might be adapted to a number of small furnaces running on a track and brought, one after another, under the electrodes.

Electric Furnace Steel in Italy

THE First World Power Conference which was held recently at Wembley, though it did not attract a large attendance, was not lacking in valuable papers of a truly international character. Among those of metallurgical interest was one presented by Dr. F. Giolitti dealing with the electro-metallurgy of iron and steel which has been developed to a great extent in Italy during the past few years. Italian conditions are such as to favour electric power developments rather than other methods, although there is no great plenitude of suitable water supplies. For metallurgical purposes the most important factor is the deficiency of suitable ores, and the absence of coal suitable for the production of metallurgical coke. The engineering demands for steel are increasing, so that the conditions are thus naturally favourable for the development of the electric furnace processes for producing steel from scrap. This process has undoubtedly also been favoured by the abnormal conditions following the war period, and it is significant to note that the production of electric steel in Italy increased from 20,000 metric tons in 1915 to 74,000 metric tons in 1918, 119,000 tons in 1920 and 158,000 metric tons in 1922. The number of electric furnaces for steel manufacture rose from 12 in 1914 to 178 in 1922, these figures representing a far larger ratio of increase in output than occurred in the total output of steel in Italy.

During the war a number of small firms entered the field and operated small furnaces, but since that time these have largely gone out of business and furnaces of medium (6 to 10 tons) or large capacity (10 to 20 tons) have produced the greater part of the electric steel. Plain carbon steel forms the greater bulk of the output, but all special steels and many of the steel castings manufactured in Italy are obtained with the electric furnace. The total capacity of the furnaces at present in existence for the manufacture of electric steel may be estimated at 800,000 tons per year. Although the conditions which fostered the development of this industry were abnormal, Dr. Giolitti considers that even as those resulting from the war gradually disappear electric furnace steel will continue to expand in Italy because a coal consumption of only some 140 kg. is required to produce one ton of steel electrically as against over 700 kg by Siemens-Martin furnaces using pig iron and scrap steel changes. This is a factor of considerable importance in a country with a growing industrial output and meagre coal supplies, and it seems likely that if necessary the electric steel industry would receive protection by the Government if it were to show signs of declining through external competition.

Direct Manufacture of Pig Iron

THE electric furnace has been used in Italy also for the production of pig iron, in 1918 the output being as high as 62,000 tons. This was entirely what may be termed "synthetic" pig iron prepared by smelting and carbonising steel turnings in the electric furnace. After 1918 the demand collapsed, and the output was some thousand tons only, the furnaces being turned over to the production of ferro-alloys. An important plant for the electric reduction of iron ore is now in course of erection, however, at Hosta, for the treatment of certain very pure and rich magnetite ores found at Cogne. One furnace has been working already for about a year, with satisfactory results, producing pig iron direct. There are to be six 4,500 kW furnaces in all, and the works will make use of a well-designed combination of electric shaft furnaces and electric open reducing furnaces, so that considerable amounts of waste power may be used and various ores and reducing agents employed to their best advantage. The pig iron will be used for the electric manufacture of high-grade steels and ferro-alloys at a neighbouring works.

Electrolytic Iron

MR. T. W. S. HUTCHINS in his paper before the World Power Conference described in some detail a plant which is being put into operation in Cheshire for the production of iron tube, sheet, etc., by electrolytic means. This process is, of course, to be distinguished from the electrolytic building-up methods investigated by the Air Ministry during the war, and the similar "Fescol" process for the electrodeposition of nickel. In the process described the iron is obtained both from the anodes which are soluble and from the recuperators which keep the electrolyte up to strength. Either scrap iron or iron ore is used for both these purposes, the anodes not being of definite form. The electrolyte is circulated by a centrifugal pump through the four depositing vats, two recuperators and filter chamber which form the plant. Electrolytic iron is liable to two principal defects (1) rough, uneven or spongy deposits and (2) pitting caused by so-called hydrogen craters. Though these are commonly thought to be avoided by having an acid electrolyte, it has been found that only a very slight degree of acidity is required corresponding to ·0000158N. H_2So_4 (P_H 4·8) to produce a smooth non-porous deposit. It was found that the tendency of the acidity to rise above this figure was due to impurities in the iron in the recuperators preventing free access of the electrolyte, and the difficulty was overcome by increasing the velocity of flow in the electrolyte and so inducing a scrubbing action. This, however, did not stop the formation of pits, or so-called hydrogen craters, which, however, were eventually found to be caused by hydrogen evolved in local galvanic action due to solid impurities in the electrolyte, and the inclusion of a suitable filter in the circuit removed this difficulty.

The Cost and Results of the Process

MR. HUTCHINS gives numerous details of the cost of current, treatment and removal of the tubes, sheets or other objects obtained, too numerous more than to mention in a note of this kind. Taking the cost of power at 0·3d. per kilowatt-hour, and assuming a current efficiency of 95 per cent., the cost of the current required to produce a ton of iron is £2 19s. at a voltage of 2·3, being higher at higher voltages and *vice versa*. The cost of raw material required to produce one ton of iron, assuming £4 per ton for scrap or £3 per ton for ore would be £4·44 and £3·33 respectively. The cost of removal of the deposited metal and after treatment is estimated at £2·625 per ton, so that without overhead charges which are too variable to form a basis of comparison, the cost per ton for electrolytic iron works out at about £8·8 to £9·9 per ton.

A specimen of iron obtained by the above electrolytic process was submitted for analysis to the National Physical Laboratory, giving the following figures:—Carbon 0·031 per cent., manganese 0·02 per cent.; silicon, sulphur and phosphorous, trace; copper and nickel, nil. Microscopic examination showed that the annealed specimens contained ferrite crystals of moderate size, typical of annealed pure iron, with a fair number of inclusions in most cases. Un-annealed specimens showed a peculiar radiating structure with very elongated crystals.

The process is evidently on a practical basis, and for the production of iron of a high degree of purity it should prove of value.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

THE only good thing that can be said of the month of July, so far as the iron and steel trade is concerned, is that its passing has brought us so much nearer the time when the depression shall lift and the steel maker have some hope of reward for his labours; and when that has to be said things are indeed dismal! This season in any year is expected to be dull in comparison with the rest, but the present inactivity is more than usually pronounced.

The course of trade this year has followed very closely the lines of last year. At the beginning of 1923 there was a spurt which lasted for a few months and then subsided. Its ultimate cause—the French invasion of the Ruhr—was too illusory to bring about any real revival. By the middle of the year its effect had worn off, and for a few months trade was at a standstill. At the end of the year a fresh impetus was given by the railway contracts, and this carried over well into the year 1924. These railway orders, however, did not represent normal trade requirements. They were substantial enough to raise the hope that they would set in motion a regular flow of trade, but this has not been realised. There is little or no ordinary trade about; demand seems to have ceased, and we can only wait for the closing months of the year which may bring an upward movement to correspond with the past two years.

There is some comfort in the fact that the railway companies have not finished their constructive programmes. Orders are still being given out, although not so plentifully; and an appreciable amount of regular orders may be expected for renewals and repairs.

Coming Upward Movement

That an upward movement will take place in the autumn seems to be the general opinion in trade circles. It may be that the wish is father to the thought, At any rate no harm can be done by encouraging the expectation. We still think that a settled feeling of confidence is what is wanted to make things move. There is money in the country and in the hands of those who, when they feel that the right time has come, can send it out to bring life and vigour into the heavy industries which are languishing for the want of it.

For that reason everyone is looking with great interest to the result of the deliberations of the London Conference on the reparations question. There is still the possibility of an agreement being reached which will heal the wound from which Europe has been suffering so long—and far longer than it ought to have done—and if that object is achieved there is hope for those who are struggling to keep our industries on their feet. The situation is more immediately pressing for us than for France. By her action in the Ruhr France has laid up for herself trouble which she will eventually have to meet. For the moment she has been willing to pledge future for present gain. Her industries are in full swing and unemployment is practically unknown. We, on the other hand, have sections of the vital industries of the country which are finding the utmost difficulty in carrying on; and we have an unemployment list of over a million.

German Competition Bogey

The first need is for a settlement of the reparations problem, and the next is for an arrangement of the terms on lines which will not unnaturally or too severely handicap British trade. The fact has to be faced that when an understanding is reached on the question of German economic restoration, the competition from that country will be keener than ever. Already the National Union of Manufacturers is petitioning both Houses of Parliament "to call attention to the grave danger to British industry and increased unemployment which may result from the Dawes Report being put into operation." It is no use denying that the danger is there, but we have had past experience of competition from Germany, and it has never succeeded in reducing our trade to a state of impotence. When the choice lies between the elimination of German competition by political repression, and a settlement of the reparations question which will give peace to Europe, even though it brings unexampled trade competition in its train, there can be no flinching from the acceptance of the second alternative. Let us get the world trade moving again. Competition will then find its own level.

Lifeless Condition of Market

The quarterly meeting at Birmingham reflected the lifeless condition of the market. There was a moderate attendance of buyers and sellers from all the chief trade centres, but the general impression one received was that they had come to condole with each other and to see whether there was encouragement of any kind for the future. Of real business demand there was very little. There was the feeling that the cessation of buying has lasted too long. Even reductions in prices do not bring orders of any great moment. Where purchasers are made they are only to cover immediate wants. The position is causing anxiety to many of the works. One large firm in the north of England has already found the difficulties too great and has suspended operations. Others are wondering how long it will be before they have to follow suit. Particularly in the iron trade is the situation desperate. Messrs. J. and C. Holcroft, of Tipton, are reported to have closed down for an indefinite period, the first time for more than 100 years. Several other ironworks have also gone out of action.

Bar Iron Advanced in Price

Some surprise was expressed when the South Yorkshire ironmakers officially advanced the price of bar iron 10s. per ton in the early part of the month, but it was a logical step. The cost of making the iron has for some time been above the selling price. So many works have found it impossible to keep going on this condition that those who remain have determined that if Yorkshire iron bars are wanted a price will have to be paid for them which will reduce the loss which has been incurred in making them.

In the pig-iron section there is nothing good to report. The export trade is lifeless and the home trade is exceptionally quiet. Prices quoted are largely nominal and are shaded to suit any business offering. Cleveland iron cannot hope to secure any appreciable share of the export trade against the prices which are quoted by the French and Belgian makers, the difference being anything from 5s. to 7s. per ton. The ironfounders at home have not too much work and they are limiting their buying to the utmost. The market for basic iron is hopeless. A sale has been made as low as 86s. in Lancashire, delivered to the works. Altogether the position is causing much anxiety to the blast furance owners. Stocks of iron at makers' works are accumulating, and the alternatives are either to continue making for stock or blow out furnaces. Each is a step involving considerable loss. It is true that there has been some relief in coke prices, but this was long ago discounted in the selling price of pig iron. There is a feeling that coke prices have not yet reached the bottom, but the coke makers are faced with practically the same difficulty as the iron makers. Some of them are talking of shutting down the ovens rather than accept lower prices.

Reduced Output in Steel

The steel trade has the same weakness and depression to report. Most of the works are on reduced outputs. There is not sufficient shipbuilding to cause any noticeable demand for plates and sections. For ordinary plates the price stands at about £10 per ton, which is considerably below cost. Sections are being sold at £9 7s. 6d. to £9 10s., and there is the keenest competition between the various rollers for any good order that comes on the market. Steel sheets and steel for the motor trade continue in fairly good demand. Those makers who have developed a market for "quality" steels, steels for special purposes, such as motor car work, deep stamping and pressings, etc., are somewhat better off than those who rely principally on the common trade.

Those works whose sole activity is the manufacture of steel are passing through a very trying period, more so than works who have other lines to which they can look for profits. These latter are able to set off the loss on steel making against

the profits realised in other departments; and so long as they can do this it is to their interest to keep the steel works going, even at a loss, rather than close them down. At the same time it introduces a competition which bears hardly on the works whose only production is steel. There is no doubt that in this way prices have been forced down more than necessary, and there are instances where this has been carried to an extent altogether unjustifiable.

It is no exaggeration to say that some of the large works would welcome a reasonable excuse for closing down until this period of depression has passed. Holidays are made an excuse for longer stoppages than usual. It is a point which trade union leaders would do well to bear in mind when pressing the claims of some of their followers. Messrs. Alfred Hickman, Ltd., are closed down owing to a labour dispute, and other firms are ready to do the same thing rather than give way to demands which add to the burdens which are already being carried.

The output figures for June are interesting, as they show the decline in the iron and steel trade. The production of pig iron amounted to 607,800 tons compared with 650,900 tons in May and 692,900 tons in June, 1923. There were six furnaces less in blast at the end of the month than at the beginning, the total being 185, which is the lowest since January, 1923. The output of steel ingots and castings amounted to 651,500 tons compared with 809,700 tons in May and 767,700 tons in June last year. The Whitsuntide holidays accounted for some of the reduction. It will be interesting to see what the July figures are.

New Steel Furnace Installed

It is interesting to note, however, that Vickers have just installed at their Barrow-in-Furness works a new open hearth Siemens steel furnace of the very latest type, built and designed by Wincott's of Sheffield. The capacity is between 10 and 20 tons per heat, and it is now possible to get a total output from the steel foundries at the Vickers Barrow works up to 300 tons of castings per week, ranging from a few pounds weight each to a 20-ton casting. Castings to Admiralty, Lloyds, and Board of Trade requirements, such as ship's structural work, can now be made at the Vickers Barrow works up to the above figure. In addition, it is anticipated that a good proportion of the output will be absorbed for commercial castings. The first heat was tapped from this furnace on July 18, with very successful results, as determined from the test figures and analyses, and it will now be possible for the firm to give special attention to the production of steel castings of every description up to 20 tons weight.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Tungsten Alloys

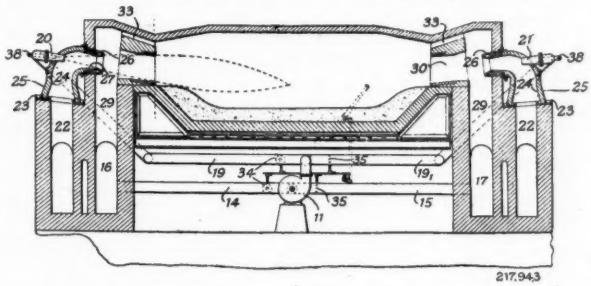
APPLICATION has been made by British Thomson-Houston Co., Ltd., of London (assignees of G. R. Fonder, of Schenectady, N.Y., U.S.A.), for two patents of alloys of tungsten suitable for electric lamp filaments. In one case 0·5 per cent. of thorium and 0·25 per cent. of copper are added to powdered tungsten, and the mixture sintered and swaged. Potassium silicate may also be added for filaments for use in gas-filled lamps. In another case, a tungsten alloy containing thorium and boron is obtained by adding 0·5 per cent. of thorium or 0·7 per cent. of thorium oxide, and 0·5–0·3 per cent. of boron nitride. Filaments made from these mixtures are heated to high temperatures, so that the boron nitride decomposes and the boron reduces the thorium oxide to thorium. See Patent applications Nos. 215,347–8, having the International Convention date May 1, 1923.

Vanadium

Two applications have been made by A. Wittig, of Berlin, for patents for processes for obtaining vanadium. In the first, a vanadium compound, such as vanadic acid or ferric vanadate, is first heated with a nitrogen compound, preferably ammonia or ammonium salt, to a red heat. Vanadium nitride is formed, and an increased yield is obtained, and this is subjected to thermo-aluminic reduction. In the second case, vanadium ores containing copper, lead and zinc are treated with sulphuric acid and sulphurous acid or a sulphite to dissolve the vanadium, About 5 parts of sulphurous acid are used to 100 parts of ore. See Patent applications Nos. 215,734 and 215,737, having the International Convention date May 7, 1923.

Metallurgical Furnaces

A METALLURGICAL furnace has been patented by F. H. Loftus, of Pittsburgh, Pa., U.S.A., in which air is introduced at a high velocity from a regenerating chamber together with the fuel, and the combustion products are withdrawn at a lower velocity. The furnace is adapted for obtaining very high temperatures. An electric fan 11 is mounted below the floor of the furnace, and has two intake pipes 14, 15 opening into pockets 16, 17 near the ends of the furnace. Two discharge pipes 19, 19^1 communicate with booster nozzles 20, 21. The gas uptake 22 carries a stream line refractory elbow 24 having an outer metal shell 25, which rests in a pan of sand 23 to form a seal whereby the elbow may be adjusted without



interfering with the flow of gas. The elbow is elliptical in cross section, and has a reduced water-cooled nozzle 26. The nozzle discharges across the air uptake 29 into a mixing nozzle 30 having a restricted throat. This arrangement enables the length of the gas nozzle to be reduced. A wide and shallow flame is directed on to the bath of steel, and an additional air inlet 33, which is always open, allows a curtain of air to enter and form a protection for the silica roof and side walls. Booster nozzles 20, 21 are mounted in the elbows 24, and a pipe 38 may be provided for the supply of compressed air or superheated steam if the fan is out of action. In some cases, inert gas may be taken from the outgoing end of the furnace and injected through the elbow 24 at the incoming end. The flow of air to the furnace is reversed by the manipulation of valves 34, 35 in the pipes 14, 15, 19, 19^1. See Patent No. 217,943, dated January 22, 1923.

Manufacture of Steel

A PROCESS for the manufacture of steel of improved physical properties has been patented by W. P. Thompson, of Liverpool. (Communicated by Commercial Steel Company, Chicago, Ill., U.S.A.) This treatment involves the subjection of a bath of steel to a sudden explosive shock immediately before pouring. A suitable explosive mixture consists of finely powdered charcoal 2–4 lb., potassium chlorate 4 oz., and barium dioxide 8 oz., this quantity of mixture being used per ton of steel. The mixture may be added to the steel bath in a steady stream or in successive charges at intervals. The amount of each charge should be as high as possible consistent with safety, and each charge is added after the agitation due to the preceding charge has subsided. In the use of a Bessemer converter, the explosive mixture may be blown in with the air bath. To prevent change of carbon content, it is desirable to add a quantity of tungsten concentrates or chrome ore before adding the explosive charge. The steel obtained in this manner is not chemically different, but has improved physical properties. A steel can be obtained with not more than 0·50 per cent. of carbon, which, when cast and normalised has a tensile strength of 90,000–100,000 lb. per sq. in. The steel varies in tensile strength by 8,000–10,000 lb. per sq. in. for each difference of 0·10 per cent. of carbon. See Patent No. 217,963, dated March 15, 1923.

Low-Carbon Steel of Unusual Strength

MR. R. H. SMITH described recently in a paper given at Atlantic City, U.S.A., how he had been able by using a sufficiently large body of cooling water to increase the breaking-strength of low-carbon steel (0·1 per cent. carbon) to 130,000 lb. per sq. in., about three times as great as that of any similar steel previously made.

Current Articles Worth Noting

We give below a brief index to current articles in the technical press dealing with metallurgical subjects.

ALLOYS.—Properties of fusible alloys. N. F. Budgen. *J.S.C.I.*, July 4, 1924, pp. 200-203 T. The alloys in question are binary, ternary and quaternary mixtures of lead, bismuth, tin and cadmium, together with quin-ternary alloys containing mercury in addition.

The behaviour of aluminium-zinc alloys. O. Bauer and W. Heidenhaim. *Z. Metallkunde*, June, 1924, pp. 221-228 (in German). The physical and chemical properties of the complete range of alloys.

Light alloys of aluminium. W. Rosenhain and S. L. Archbutt. *Metal Ind. (Lond.)*, Part I., July 4, 1924, pp. 3-7; Part II., July 11, 1924, pp. 27-30 and p. 44. Discusses the properties of the chief alloys, their heat treatment and industrial application.

ZINC.—The zinc industry in Belgium. N. F. Budgen. *Metal Ind. (Lond.)*, Part I., July 11, 1924, pp. 31-34; Part II., July 18, 1924, pp. 53-58. A description of modern smelting practice.

CORROSION.—The submerged corrosion of iron. Part II. W. G. Whitman and R. P. Russell. *J.S.C.I.*, July 4, 1924, pp. 197-199 T. Discusses acid corrosion effects, and the distribution of anode and cathode areas; concludes that corrosion can be adequately explained along electrochemical lines.

Effect of hydrogen-ion concentration on the submerged corrosion of steel. W. G. Whitman, R. P. Russell and V. J. Altieri. *J. Ind. Eng. Chem.*, July, 1924, pp. 665-670. Considers the corrosion of steel immersed in natural waters, dilute alkalies, and dilute acids, and shows that the results are in accordance with general electrochemical theory.

Corrosion of monel metal in photographic solution. J. I. Crabtree and G. E. Matthews. *J. Ind. Eng. Chem.*, July, 1924, pp. 671-675. Shows that, except when exposed continuously to strong acid fixing solutions, photographic apparatus constructed of monel metal is quite satisfactory.

CASE-HARDENING.—The case-hardening of steel by boron and nitrogen. T. P. Campbell and H. Fay. *J. Ind. Eng. Chem.*, July, 1924, pp. 719-723. An experimental study of iron-boron and iron-boron-nitrogen alloys.

ELECTRO-METALLURGY.—Progress in the electrolytic refining of metals during the last decade. S. Skowronski. *Chem. Age (N. York)*, June, 1924, pp. 269-273.

Studies on electro-plating. Part III. Addition agents. W. E. Hughes. *Metal Ind. (Lond.)*, July 11, 1924, pp. 25-27, July 18, 1924, pp. 49-53, and July 25, 1924, pp. 73-75. Theories underlying the function and action of such agents.

PICKLING.—Pickling of iron and steel; a bibliography. V. S. Polansky. *Blast Furnace and Steel Plant*, July, 1924, pp. 326-328.

STEEL.—The carbides in nickel chromium steels. J. H. Andrews and H. Hyman. *J. West of Scotland Iron and Steel Inst.*, March-April, 1924, pp. 116-123.

The quantitative estimation of iron carbide in the common carbon steels. E. Maurer and F. Hartmann. *Z. anorg. u. allg. Chem.*, June 19, 1924, pp. 75-89 (in German).

FURNACES.—Electric furnace development. F. Hodson. *Blast Furnace and Steel Plant*, July, 1924, pp. 314-318.

GENERAL.—The application of X-ray crystal analysis to metallurgy. E. C. Bain. *J. Ind. Eng. Chem.*, July, 1924, pp. 692-698. Describes the utilisation of the method for the study of allotropy, solid solutions, coring, grain size effects, the identification of new constituents and preferred orientation by extreme cold work.

HAFNIUM.—The hafnium content of zirconium minerals. G. v. Hevesy and V. T. Jantzen. *Z. anorg. u. allg. Chem.*, Part I., February 19, 1924, pp. 113-118; Part II., June 27, 1924, pp. 387-392 (in German). Occurrence of the last-discovered element.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that occur.

Mortgages and Charges

*[NOTE.—The Companies Consolidation Act, of 1908, provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]*

ALUMINIUM CORPORATION LTD., London, S.W. Registered June 28, £250,000 B debentures and £500,000 C debentures (filed 1908), present issues £104,500 B and £350,000 C; general charge (subject to prior debentures and certain guarantees). *£760,060. November 22, 1923.

BEARDMORE (WILLIAM) AND CO., LTD., London, S.W., steel manufacturers. Registered July 11, £600,000 (not ex.) bond of credit and disposition in security, to Bank; charged on lands and works at Parkhead, Glasgow, etc., with forges, factories, buildings, stores, fixed machinery, etc. *£1,088,478 17s. 4d. August 23, 1923.

CHADWICK (JAMES) (IRONFOUNDERS), LTD., Bolton. Registered July 11, £15,000 debenture to Naneibelle Grant, 390, West End Avenue, New York, U.S.A.; general charge. *£8,500. October 4, 1923.

FLEXILE METAL CO., LTD., London, N. Registered July 4, £5,000 debentures; general charge. *£5,000. June 20, 1924.

NEILL (W.) AND SON, LTD., St. Helens Junction, iron-founders. Registered June 30, debenture to Bank; general charge. *£3,600. August 13, 1923.

Satisfactions

NEILL (W.) AND SON, LTD., St. Helens Junction, iron-founders. Satisfaction registered June 30, £10,000, registered April 28, 1924.

SHIPHAM AND CO., LTD., Hull, brassfounders. Satisfactions registered June 26, £4,000, part of amount outstanding July 1, 1908, £1,000, registered June 10, 1903, and £2,000, part of amount registered April 27, 1915.

New Heat-Resisting Materials

DR. WALTER ROTH, writing in *Industrial and Engineering Chemistry*, draws attention to two new refractory materials which have been developed in Germany by Rudolph Schnabel, known as Keramonit and Thermonit. Keramonit consists of a skeleton of metal wire fabric embedded in a ceramic mass, and is extremely resistant to abrupt temperature changes. Thus, red hot keramonit crucibles can be plunged into cold water without breaking, and it is stated that hollow objects of the material are practically unbreakable, even with a wall thickness of only 0·5 mm. Thermonit, which is made in an electric oven, is used as a paint, mortar or stamping material, and resists the highest temperatures that can occur in industrial furnaces. It is applied by the brush in the form of a mash mixed with water.

Swedish Iron Trade

A REPORT issued by the Swedish Foreign Office states that in the early months of this year, and during the last months of 1923 the ironworks were kept busy, but things had since become slacker. The quotations for the export of pig iron have fallen, and the market is dull. Detailed figures of the number of furnaces in operation given in the report show that this is only about half those in existence. The exports of iron and steel have been maintained at a fair level, by far the greater part being taken by Germany. The iron ore export which has suffered for a long time from the Ruhr occupation now shows signs of a normal increase which it is hoped will continue.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

The Advantages of Overlapping

THE avowed object of many of the Research Associations which have come into being since the war is to avoid overlapping in scientific research. Numerous investigators are, it is claimed, engaged independently on similar lines of research and thus—fruitlessly—repeating experiments which others have already carried out, and thus, it is implied, wasting time and energy. It may be wondered if the argument is really a sound one. No doubt, in some instances, investigators would save a certain amount of time and energy if the results of previous investigations on similar lines were known and available to them. In these days when so many journals and so many institutions publish excellent abstracts and digests of "the world's work," there is very little excuse for a scientist not knowing what has been done before along the lines of his own special investigation. On the other hand, it is an almost unmixed advantage to have a given problem attacked by a number of independent observers working along different and independent lines. A little overlapping will do us no harm, and may do us a considerable amount of good in lending greater confidence to our results.

The Bibliography of Metallurgy

A CONFERENCE is being held at Hoddesdon, near Broxbourne, this week end, on Bureaux of Information and Special Libraries. At the opening session the subjects of discussion will be the collection, classification and distribution of records, while other subjects include such interesting matters as the functions of "special" libraries, the collection and utilisation of abstracts of technical literature, and the rôle of scientific technical and trade papers. As the text book, the Proceedings of technical institutes, and the technical journal constitute the chief tools of the practising technician, it will be seen that the objects of the Conference are of very real interest to the metallurgist, and for this reason its proceedings deserve more than only passing reference. A library is much more than a mere collection of books, and a librarian needs to be much more than only their curator. The catalogue of a technical library should be a key to the library contents. Its purpose both resembles and differs from that of an index or a bibliography. The latter may aim at being exhaustive. The library catalogue is limited by the number of publications actually stored upon its shelves, and its true function is to render available not only their titles, but their actual contents. Unfortunately the two things do not necessarily correspond.

Classification and Nomenclature

A CLASSIFICATION—of sorts—is provided by arranging titles and authors' names into alphabetical order, and leaving it at that. If the seeker after information is limiting his search to the work of a specific author, this rough approximation to what a catalogue should be will serve. If, however, he wishes for specific information on some particular subject he must know the names of every author who has written on that subject, or, alternatively, he must rely upon a subdivision of subjects, an index, so omplete and meticulously exact, that he will find what he needs under one or more key-words corresponding with nearly every possible combination of words embodying the nature of the information sought. In any case he is handicapped from the start; the alphabetical catalogue, like a list of first lines in the hymn book may serve if he can remember what the first line really is. As an instrument of research it is plainly inadequate. A classification into categories is clearly necessary and this classification must be as complete and as perfect as possible. It devolves, therefore, on the librarian of a special library to devise a categorical classification which will suit his speciality. To do this properly he must either be a specialist himself, or have a scheme of classification ready prepared for him by some one who *is* a specialist, not a "library" expert, but an expert in his subject. And, in the final analysis, the nature of the categories must depend upon the technical nomenclature current in the science, art or industry concerned, and upon its correct employment.

Misleading Titles

METALLURGY, one of the oldest of the arts, is one of the youngest of the sciences. Controversies have raged as to the meaning and definition of some of its commonest standard terms. The meaning of the word steel has changed and is still changing. What, for instance, is "Armco" iron? Yet, unless the librarian himself knows, how shall he "place" it; how render information respecting it available to one to whom all iron is either "cast" or "wrought" and all steel a eutectic containing 0·89 per cent. of carbon? The term metallography, strictly means a writing about, or description of a metal; metallurgy means more than the art of extracting a metal from its ores. Yet the restricted sense of metallography is the description of the appearances of a metallic surface differentiated by the application of reagents. Finally, its accepted sense includes the operation and its results; the process and the appearances; the internal structure, and often, alas, much else. Numberless writers speak of "cementing" when they mean case hardening, and are not a whit concerned with the manufacture of blister bars. Often, too, more information can be found on a specific question in a well written general "text book" than in an inadequate and badly written special treatise purporting to deal with the very point respecting which information is sought. It is obvious therefore that the librarian must be himself an expert, otherwise *quis custodiet ipsos custodes?*

Library "Schemes"

THERE are, it is true, library schemes which purport to meet his case; Dewey, and decimal classifications of almost infinite variety. Most of these schemes are, however, of an *a priori* nature and do not fit the stubborn material of which the library consists, namely, the books themselves. The librarian must deal with his books as he finds them, or the reader will be wholly led astray. It is a good thing then for the librarians to come together and discuss their troubles, even if it leads in the main to the discovery that there is no royal road to success, and that the special library needs special treatment by one specially qualified for his task by a knowledge, not of books, but of subjects and contents.

The Constitution of Basic Slag

By T. P. Colclough, M.Sc., B.Met.

The writer draws attention to the leading part which the slag plays in guiding the operations of the steel-maker. For this reason alone the constitution of the slag, the relation between varying slags, and the rate of the various actions proceeding are considerations of first-rate importance.

In the making of steel by the open-hearth process, the elimination of the impurities in the metal is essentially the result of reactions between these impurities and the slag floating on the surface of the molten metal. Further, since the slag is the only portion of the bath which is visible to the melter, it is mainly by the appearance of the slag that the operations of the steel-maker are guided.

In the " acid " process, silicon and manganese in the metal are reduced to almost negligable proportions in the earliest stages of the heat, sulphur and phosphorus cannot be altered, and carbon is the only element the elimination of which is to be controlled. The reactions between the oxides of iron and carbon have been carefully studied, and, the constituents of the slags being relatively few, the process of " acid " steel-making is now fairly well understood. In the " basic " process, besides carbon the melter has to control the proportions of manganese, sulphur and phosphorus ; the slag may contain, under differing conditions, many different constituents and reversible reactions are much more liable to occur. As a result the study of " basic " steel-making is exceedingly complex and much difference of opinion still exists.

The essential constituents of a basic slag are silica—from the ore and limestone used, and oxidation of the silicon of the metal ; oxides of manganese and phosphorus—from oxidation of these elements from the bath ; oxides of iron from the ore used ; and lime, magnesia, and alumina from the dolomite bed or limestone additions.

Silicon

In all steel-making processes by the purification of crude metal, silicon is normally the first element to be removed by oxidation forming silica. This floating to the surface unites with the metallic oxides present to form a slag, the basis of which is essentially a silicate. It is now generally agreed that this silicate in the basic open-hearth process is a mono-silicate of form $2RO.SiO_2$, where RO may be CaO, MgO, MnO, or FeO. It has been suggested by one writer that it is possible, under certain conditions, for some of the silica to be present as " free " silica in solution. It is somewhat difficult, however, to imagine how free silica could exist in a slag carried on a bed of CaO and MgO.

The character of the metallic constituent of the silicate varies according to the nature of the slag, and recent work seems to show that, as more and more CaO or limestone is added to the bath, the bases FeO, MgO, and MnO are progressively displaced until a purely calcium silicate—$2CaO.SiO_2$—is formed, the remaining bases being held in solution in the molten matrix. The essential matrix of a basic slag is therefore calcic mono-silicate, and this appears to be the stable constituent, as no examples have been recorded of any increase of the silicon content of the metal due to reduction of the silica of the slag.

Phosphorus

The phosphorus of the metal is readily oxidised to phosphoric oxide by oxide of iron in accordance with the equations :—

$$5\ FeO + 2P = P_2O_5 + 5Fe.$$
$$\text{or } 5\ Fe_2O_3 + 2P = P_2O_5 + 10FeO.$$

Unfortunately, the P_2O_5 thus formed is as readily reduced by carbon unless it is held in combination with CaO as calcium phosphate. The constitution of this compound is open to discussion. It is agreed that it is of the form $x\ CaO.P_2O_5$, but the differing values of 3, 4 and 5 are given to x by different investigators. The late Dr. Stead firmly established the presence of crystals of tetra-calcic phosphate in slowly-cooled slag, but in view of the changes which may occur in cooling this cannot be accepted as final proof of its existence, as such, in the liquid slag. J. E. Fletcher [1] has sought to show that the compound has the formula $5CaO.P_2O_5$, but no experimental evidence is given, and the whole argument is based on the calculations made from the analysis of cold slag. J. H. Whiteley is of opinion that the compound is the *tri*-calcic salt, and in a valuable paper to the Cleveland Institute of Engineers (1922) produces much evidence in support of this. In this paper, however, he assumes the existence of a constituent, a compound of CaO and Al_2O_3, the reality of which is open to doubt, and his conclusions are, therefore, not proven.

In later work [2] there is given the result of an attempt to determine the equilibrium point between SiO_2, P_2O_5, and the bases in the slag, and so to determine the " critical " basicity of a slag, at which the slag would be saturated with phosphoric oxide. The charge put in the furnace carried a low amount of lime, and the slag at melting corresponded almost exactly to a mixture of $2RO.SiO_2$ with $4CaO.P_2O_5$. Additions of lime and ore were made for two hours and the oxidation of carbon and phosphorus proceeded simultaneously, there being a slight excess of base in the slag to combine with the oxide of phosphorus as it was formed. At this stage, sand (SiO_2) was added to the slag to reduce its basicity. Immediately a change in the reactions occurred. The oxidation of carbon proceeded normally, but that of phosphorus ceased and was replaced by the reduction of P_2O_5 from the slag—the phosphorus content of the metal *rising*—i.e., the process as regards phosphorus was reversed. After the lapse of an hour, more lime was added ; again the process was reversed and the oxidation of phosphorus resumed.

Throughout the whole of this period, allowing for time lag due to diffusion and the viscosity of the slag, there is a remarkably close parallel between the molecular proportion of P_2O_5

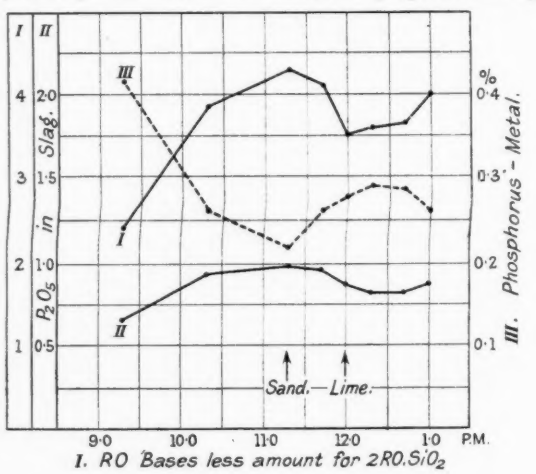


FIG. 1.

and the surplus of bases after allowing for the formation of the mono-silicate (see Fig. 1), showing that when a slag is saturated with phosphorus the CaO/P_2O_5 ratio is 4/1. This evidence strongly supports Stead's view that the compound formed is *tetra*-calcic phosphate $4\ CaO.P_2O_5$. This compound is the second essential constituent of a basic slag.

Alumina

The amount of alumina present is normally small, not exceeding 5 per cent., and is mainly accidental, but owing to its amphoteric properties its state of combination is open to dispute. Both Fletcher and Whiteley suggest that it acts as an acid, the latter claiming that it forms a compound with CaO as $2\ CaO.Al_2O_3$, the former that it forms $3\ FeO.Al_2O_3$. It should be recognised that with so many constituents present there are possibly ternary or quaternary compounds formed, and in this respect the work of Rankin, Day, and Shepherd [3] is of value.

1. Fletcher. W. of Scot. I. & S. Inst. Vol. 29, Pt. 7.
2. Colclough. J.I.S.I. 1923. Pt. i.
3. Amer. Jour. Sci. Vol. 34.

Their diagram for the ternary system SiO_2, Al_2O_3, CaOshows—

i. No evidence of a compound $2CaO.Al_2O_3$.
ii. A definite compound $2\ CaO.SiO_2$.
iii. A definite compound $2\ CaO.Al_2O_3.SiO_2$.
iv. That mixtures of $2\ CaO$, to $I\ SiO_2$ with a little Al_2O_3 such as are found in basic slags form a continuous series of mixtures or solutions between the compounds ii. and iii. This points to there being no definite calcium or ferrous aluminate but rather an alumino-silicate in which the CaO/SiO_2 ratio is still 2/1 as in the simple silicate.

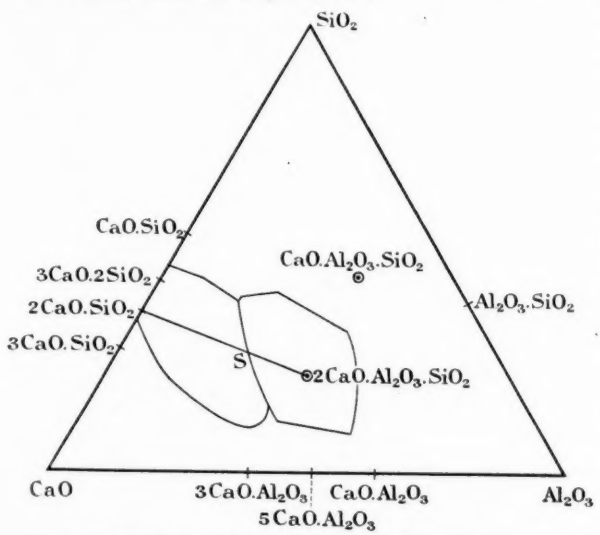


FIG. 2.—SHOWING BINARY AND TERNARY COMPOUNDS OF CaO, SiO_2, AND Al_2O_3, AND THE PORTION OF THE TERNARY DIAGRAM DEALING WITH BASIC SLAGS.

In the absence of other evidence it can be assumed, therefore, that the effect of alumina is neutral and has no bearing on the reactions, or combining proportions of the other constituents.

Magnesia

The evidence given above seems to show that in "thin" slags, i.e., those low in CaO, MgO functions as a base to combine with SiO_2. As the slag thickens, with additions of lime, this MgO is displaced in the silicate by CaO and is held in solution as free MgO in the silicate and phosphate matrix.

Experimental evidence shows that MgO appears to be incapable of forming a stable compound with P_2O_5, but on the other hand tends to decrease the power of the slag to carry P_2O_5 thus rendering it less stable. It is common experience that with a "bottom boil"—when the dolomite bed is loosened and passes into the slag—the slag becomes very thick and viscous and the phosphorus tends to return to the metal.

It is also worthy of note that the microscopic examination of "shrunk" dolomite shows no evidence of any compound of CaO and MgO.

Manganese

In the first stages of the basic process, the manganese of the metal is partially oxidised to MnO which unites with silica. This silicate is unstable in the presence of excess lime and the MnO thus left free is capable of reduction by carbon. As a result, the elimination of manganese is never so complete in the basic process as in the acid, and in many cases the return of manganese from slag to metal can be observed. It is significant to note that Scott and M'Arthur[4] in their microscopic examination of slags found that the MnO was always present in the uncombined state, i.e., was an accidental not essential constituent.

Oxides of Iron

The function of iron oxide in the basic process is in marked contrast to that in the acid. In the acid process the slag is essentially a ferrous silicate containing more oxide in solution, i.e., the FeO is an essential constituent for the formation of the slag itself as well as the active agent for the oxidation of the impurities of the metal. Further, by far the larger portion of the iron oxide is present as FeO, the amount of ferric oxide being usually about 1-2 per cent. at the finishing stages, gradually falling to this as the heat is worked. It is well established that ferrous silicate is unstable in the presence of CaO. Hence in basic slags with their high lime content there is little or no ferrous silicate and most, if not all, of the iron oxide is merely in solution in the slag. Under these circumstances it would be expected that the oxide present would be Fe_3O_4, this being the stable oxide over 1,100° C., and analysis shows a high Fe_2O_3/FeO ratio as contrasted with the figures or acid practice. It is possible that under certain conditions of working the oxide of iron may enter into combination with other constituents of the slag. For example, with low temperature and a low lime slag, it is possible to have a rapid elimination of phosphorus by heavy feeding of ore, the P_2O_5 being held by FeO, but this is merely a transient phase and lime must be added quickly to prevent a reduction of the ferrous phosphate formed by the carbon of the metal. Also, it is probable that with very high lime slags some of the Fe_2O_3 may enter into combination with CaO to form a compound of the spinelloid type, $3\ CaO.\ Fe_2O_3$, as described by Scott and M'Arthur.

In general working, however, it may be taken that the iron oxides are free, held in solution, and their function is (a) as oxidising agent; (b) to give fluidity to the silicate-phosphate matrix by lowering the fusion point of the mixture.

Spar Slags

The addition of fluor spar, CaF_2, to the slag has been common practice for a considerable time, to aid the process of de-sulphurisation, but its true function has not been clearly understood. That a slag containing spar and high lime would remove sulphur from the metal was well established, but its *modus operandi* is still a matter of speculation. The first effect of the addition of spar is that the melting point is lowered, the slag becomes more fluid, and lime must be fed to prevent attack of the dolomite banks of the furnace. In this way a slag of the same consistency, at the same temperature, will carry 46/48 per cent. CaO with spar as compared with 38/40 per cent. CaO in a non-spar slag. Recent figures[2] published show that such a slag carries its MnO in the uncombined state, reduction of the MnO begins, and manganese is added to the metal. It is common experience that manganese is an excellent de-sulphurising agent in both the metal mixer and open-hearth furnaces, and it is suggested that the function of fluor spar is not direct but indirect, being merely to give to the slag sufficient fluidity to carry the CaO necessary to liberate the MnO from the silicate and thus render it capable of reduction to Mn. It is this manganese added to the metal which is the "active" agent in removing sulphur. In support of this view, it may be noted that sulphur may be removed by working with a high temperature and high lime slag—in this case the necessary fluidity being obtained by extra heat instead of spar.

One important economic effect of the use of spar should be noted. Basic slag, by virtue of its high phosphoric acid content, possesses valuable fertilising properties especially for poor grass lands and root crops. For many years the test applied to "basic slag" has been a double one, viz., "total" phosphate and "soluble" phosphate—the latter being the amount of phosphate soluble in 2 per cent. solution of citric acid in water. The slags made without the use of spar show a high "solubility" factor, being sold with a guarantee of 80 per cent. minimum solubility. Slags made by the processes where fluor spar is used show very low "solubility" factors—as low as 10 per cent.,—with a corresponding low commercial value.

The work of Scott and M'Arthur shows that this is due to the combination of tri-calcic phosphate with the fluor spar, during cooling and crystallisation, to form the mineral fluor apatite—$CaF_2\ .3Ca_3P_2O_8$ as distinct from a silico-phosphate formed in non-spar slags. The silico-phosphate is readily soluble in the citric acid solution while the apatite is not dissolved to any extent.

To summarise: a basic slag in the furnace may be regarded as essentially a mixture of tetra-calcic phosphate and monosilicate of lime, containing in solution greater or smaller amounts of oxides of iron, manganese, with alumina, magnesia, and in special cases fluor spar—the function of the latter being purely a physical one, to give greater fluidity to a slag of the required lime content

4. Scott & M'Arthur, as i.

2. Colclough. J.I.S.I. 1923. Pt. i.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Iron and Steel Institute Meeting

THE meeting of the Iron and Steel Institute, which has been held this week at Wembley, has been well attended, considering that the Exhibition as an attraction must have spent much of its force, and that the programme contains no strikingly new thing in ferrous metallurgy. While not devoid of interest, the papers lean to the academic rather than to the practical side, although it has to be admitted that the distinction is at times hard to draw. There is or may be a practical side to even the most academical paper, and the speculations of yesterday often influence the practice of to-morrow. From this point of view, therefore, most of the papers may be described as helpful.

Effect of Free Surfaces on Deformation

PROFESSOR THOMPSON and Mr. Millington return to the charge with a paper on "The Effect of Free Surfaces on the Plastic Deformation of Certain Metals." Of the ultimate importance of this question from an engineering point of view there can be no doubt, and the authors deserve credit for the pertinacity with which they endeavour to elucidate the problem. Precisely what is meant by a free surface is not defined; in the context it would appear that the term is applied to the skin of a metal in the sense of the exterior delimiting boundary of the mass, and not to internal surface boundaries between crystals or phases, or atoms or molecules, which, by their position within the mass, are not "free." It is obvious, from fundamental physical reasons involving an enormous number of factors, that such a free surface differs profoundly in its physical properties from a contact surface, It possesses an altogether specific tension; it differs in texture, as is seen in polishing which affords extreme instances of the "flow" which, in varying degree, must occur at all surfaces; it exhibits phenomena of adsorption entirely distinct from absorption or occlusion, and it must be, from its very situation, more—or less—susceptible to chemical and physical change than any other, internal, surface. In respect of its influence on, *e.g.*, the elastic limit, there would seem to be some little confusion. Thus, the authors appear to view free surfaces as free from the restraint imposed by crystal boundaries, and that it is therefore not difficult to imagine that the elastic limit will be lower at the surface than it is internally.

It is not easy to follow the line of argument adopted by the authors in quoting both Coe's results, which indicate a low value for elastic limit in compression, and those of Jeffries, which shows that surface compression retards movement and so raises the elastic limit in support of their views. Their ultimate conclusion, that under all stresses the effect of free surfaces is of vital importance in connection with elastic failure is one however which no one will challenge. More work is required on the subject, and it is to be hoped that Professor Thompson and Mr. Millington will continue to cultivate the interesting metallurgical field they have made so attractively their own.

Hardness Testing

WHAT is hardness, as the term is applied to metals, and how best can it be measured, so that the results may fairly be comparable? In its simplest aspect it is resistance to penetration, and it is this property that the Brinell method seeks to measure. The Shore machine, which measures the rebound of a ball, is a measure of what may be termed elastic resilience, or elastic resistance to impact shock, a different property. The old scleroscope measures "scratch hardness," a kind of penetrative hardness somewhat akin to the Brinell number. Other machines measure abrasive hardness, or resistance to wear. The latest "hardness tester" is the Herbert pendulum machine. It is intended to measure yet a different kind of hardness—work hardness. This is defined as resistance to working with a tool. The new machine is described by Dr. Carl Benedicks and V. Christiansen, in a paper presented at the meeting on "Investigations on the Herbert Pendulum Hardness Tester." As a matter of fact, the results are practically the same as when using the Brinell test. As recently it has been found that the method usually adopted in making Brinell tests is complicated by all kinds of factors, from stresses in the Brinell machine itself to secondary perturbations due to cold work hardening in both the ball and the sample, while the test is in process, some more generally reliable and uniform method of testing hardness is urgently required. The use of the Herbert pendulum will be watched with interest. It would seem, however, to be open to many of the criticisms which have of late been levied on the Brinell test itself. Until there is some general concensus of opinion amongst metallurgists as to what they mean by hardness there is hardly likely to be any great unanimity of opinion respecting the best method for measuring it.

Pickling Solutions

A PAPER having a thoroughly practical bearing is that on "Pickling," by Professor Edwards, of Swansea. He propounds a theory as to the formation of the blisters which are so often encountered when tinning steel plates, which is in conflict with that enunciated by Law some years ago. According to Law, the hydrogen evolved during pickling, being "nascent" reduces oxide of iron in the steel and forms entrapped water vapour which, in seeking to escape, causes a blister. According to Edwards no reduction of the hydrogen is necessary. The hydrogen is in an "atomic state" and as such enters the metal until it encounters an inclusion, which may, in practice, be almost any foreign body. It accumulates in the vicinity of the obstruction, and under pressure from the advancing tide becomes molecular, and it is the internal pressure of these entrapped hydrogen molecules that causes the blister. As a remedy for this state of affairs, eletrolytic pickling is advocated, and the use of suitable oxidising reagents in the pickling acid. Swansea University in general, and Professor Edwards in particular, may be congratulated on having carried out just the kind of research which a local industry requires and which it is the proper function of a local educational institution to undertake.

Ferrous Alloys Research

THE papers to which the metallurgist will turn with perhaps the greatest interest are those which form a trilogy on Ferrous Alloys Research, under the names of Dr. Rosenhain, Mr. Tritton, Dr. Hanson and Mr. Rooney. They form what may be called a sort of interim report of the work of the new Research Committee, called into existence chiefly by the exertions of Sir John Dewrance. That committee is an exceedingly influential and representative one, and includes amongst its supporters the Royal Society, the Institutions of Civil, of Mechanical, and Electrical Engineers, the Institution of Naval Architects, the Iron and Steel Institute and the Institution of Mining and Metallurgy. That the work has been entrusted to the National Physical Laboratory, and that the direction of the researches will be mainly in the hands of Dr. Rosenhain and his able staff, will inspire confidence both in regard to the skill which will be devoted to it and to the scientific accuracy of the results which will from time to time become available. The present papers comprise an introduction by Dr. Rosenhain himself; a research on iron and oxygen, by Mr. Tritton and Dr. Hanson, and a note on the estimation of oxygen by Mr. T. E. Rooney. In regard to the main portions of the present work, that on iron and oxygen, some of the conclusions are remarkable. The iron employed was a pure electrolytic variety—purer, that is, than Armco, and by careful manipulation a material containing about 0·08 per cent. of oxygen was obtained. It was found to roll, both hot and cold, with equal ease. It was, therefore, free from the red-shortness so often attributed to even smaller quantities of oxygen, present in ordinary steel in the form of oxide. Other practical results of this research are embodied in the statements that the solid solubility of oxygen in pure iron is estimated to be about 0·05 per cent. of oxygen, and the liquid solubility at 1,530° C. is about 0·21 per cent. The presence of even the higher amount does not modify the lower arrest points. The research would seem to indicate that the

presence of slight traces of oxygen does not constitute the bogey that element is often regarded as, in rolling-mill practice.

The Properties of Duriron

An unusually interesting bulletin has been issued by the Durison Co., of Dayton, U.S.A., which deals not only with the properties and manufacture of this alloy, but gives some interesting details of the tests which it has to pass for resistance to corrosion. Duriron is an iron base alloy containing 14·25 to 14·50 per cent. of silicon. A lower percentage of silicon results in a marked falling off in its non-corrodibility. The metal can be produced in castings only, and cannot be forged, but a special technique has been developed so that practically every form of apparatus used in chemical work can now be produced by the manufacturers. Duriron, of course, resembles other somewhat similar alloys produced in England in these properties. It can be readily machined to fine limits, but it is very difficult to drill, so that bolt holes are made by using steel inserts in the casting, which are afterwards dissolved out with acid. It is not possible to thread these holes owing to the hardness of the metal, so that bolts and nuts must be used for joining plant together. It is also possible to weld the metal, using Duriron welding rods, but the operation is a little more difficult than with cast iron, owing to the greater fluidity of the molten metal. The resulting weld is as acid-proof as the rest of the casting. The melting point is 2,300° F.

Duriron is practically unaffected by hot or cold nitric, sulphuric, acetic and other acids, but it cannot be recommended with hot concentrated solutions of hydrochloric acid. Concentrations of 10 to 15 per cent. HCl, however, have little effect at high temperatures, while at ordinary room temperatures much higher concentrations can be safely used.

Standard Corrosion Tests

In order to give a practical basis for estimating the service to be expected from Duriron apparatus under operating conditions, the makers have discarded previous methods of making laboratory tests, and have adopted one which approximates the most severe conditions encountered in practice. Under average service the corrosive action is much less than that recorded in the tests. This is due to lower average temperature, absence of continuous and violent agitation, and other less exacting conditions.

The standard laboratory test consists of an eight hour immersion ; the solution being at 80° C. to 90° C. A sufficient volume of solution is used to prevent exhaustion of the acid by corrosion of the sample. Solutions are refluxed to maintain uniform concentration, and are agitated constantly and sufficiently to prevent protection of the sample by the formation of concentration cells or protective films or coatings. Before placing the sample in the solution it is ground, and pickled in 10 per cent. sulphuric acid, to remove any surface impurity ; it is then boiled to insure absolute cleanness.

After the test it is again boiled to remove any trace of acid or sulphate that may adhere to it. Great care is taken in every step so that it may result in a test as nearly dependable as possible, and from which estimates of real worth may be made. At 90° C. the maximum loss of alloy is 1·5 mg. per sq. cm. in unagitated sulphuric acid, and 2·3 mg. in agitated solutions, these maxima occurring at a concentration of 10 per cent. At 21° C. the figures are 1·0 and 1·3 mg. respectively, again at concentrations of about 10 per cent.

Direct Production of Steel from Ore

At the River Rouge plant (U.S.A.) of the Ford Motor Co. there is nearing completion a complete installation of the Bourcoud process for use in the direct production of steel from ore. The installation is under the supervision of Dr. Bourcoud, the originator of the process, a former chemical engineer, who has been working on the direct reduction of iron from the ore for many years. The Bourcoud method for reduction by gas is (*Chemical and Metallurgical Engineering* states) in no way similar in practical operation to the present methods of steel manufacture. In theory it is based upon the gas reduction of the ore as effected in the blast furnace, but the mechanism by which this reduction is accomplished is a complete departure from present methods. Its adoption would be revolutionary in character, for the blast furnace, the open hearth and the Bessemer converter become unnecessary. Good coking coal is unnecessary and any fuel, including oil, can be utilized as long as it can be gasified. Information has just been received that the first series of tests, which consisted of the gasification of powdered coal, have been completed and have given general satisfaction.

The Welding of Mild Steel

Mr. C. Coldron Smith in a recent paper before the Faraday Society, referring to the oxy-acetylene welding of mild steel, said that here we should be dealing with a material which has a melting-point of approximately 1,500° C., and being free from sulphur in phosphorus there only remains the avoidance of oxidation of the iron itself, which can be brought about by

(i) Excess oxygen in the flame itself,
(ii) Atmospheric oxygen,
and (iii) The water vapour obtained from the products of combustion of the acetylene,

the latter taking place mainly in the outer envelope of the flame is almost a negligible cause.

With a perfectly regulated blowpipe, the oxide formation in mild steel welding is very slight and in consequence fluxes are not generally used, although they are marketed. The point as to whether molten iron actually is or is not capable of dissolving up to one per cent. of the oxide is a matter of considerable variance of opinion, yet results obtained in welding a good quality of mild steel without the use of a flux, show on examination of the weld very small oxide inclusions, and mechanically the welds are not found to be weakened to any appreciable extent, as the oxide formed is less dense than the metal and rises to the surface, forming a slag which is easily removed.

The composition of the filling in material must, of course, be near as possible to that of the material to be welded. It must have a low carbon content (approximately 0·15 per cent.) in order to have as little as possible of this element to be oxidised to carbon dioxide, and so cause consequent sparking under the heat of the flame ; and the sulphur and phosphorus content must have a maximum of ·05 per cent., as these not only cause ebullition on welding, but remain in the weld causing brittleness.

Canadian Molybdenum Resources

During the war, under the influence of intensive demand, two companies in Canada treated the molybdenite concentrates and made an alloy with iron, called ferro-molybdenum, in which form it was shipped to England. They also made molybdenum salts, used in the analysis of steels and other metals. Since the war, although very little molybdenum ore has been mined throughout the world, many experiments in the making and testing of commercial molybdenum steels have been undertaken by independent investigators. In consequence of this the satisfactory results claimed in what are known as low molybdenum alloy steels ($\frac{1}{4}$ per cent. of molybdenum or under) have been proved. These steels are now used for structural and engineering purposes where great stresses and strains are involved. The good qualities of molybdenum may be summarised in saying that when it is added in small quantities to an alloy steel it acts as a stabiliser or corrective against the undesirable qualities of the other elements present in that alloy. A recent investigator states that it is the most active and potent element in steel. The sudden cessation of demand for war purposes, the very gradual increase in commercial uses, and the enormous stocks on hand, are all factors that have caused the world's production of molybdenum to be practically negligible during the last three years. Stocks are now greatly diminished and commercial uses are steadily increasing, so that it is confidently expected that mining will soon be resumed, and, in consequence of this, the Mines Branch of the Department of Mines, Ottawa, have made a special investigation of the molybdenum ore resources of Canada, and have found them to be large enough to ensure the production of considerable quantities when the demand arises.

Orders Resulting from Railway Extension

The new extension of the London Underground Railway from Charing Cross to Kennington now being undertaken has created a great deal of work in the North and Midlands. Among other contracts placed is one for 26,000 tons of cast iron segments for tunnel lining, and another for 600 tons of running rails and contact rails.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

THE month of August, as far as the iron and steel trade is concerned, has followed on the same lines as its immediate predecessors. The story has been the same, one of dulness and inaction. The holidays are in full swing, and it is no use expecting much business until they are over. Business men everywhere are chafing at the continued slackness of trade. It is probable that the early autumn will see an increase in activity, which it is to be hoped will be the beginning of a steady and progressive improvement.

In the meantime there are few signs of any quickening of demand. Many of the steel works are curtailing output because there are not sufficient orders to go round; and those works are fortunate which have subsidiary interests to help them out. The Scottish steel makers particularly seem to be in a desperate state, judging by the prices which they are willing to accept to secure orders in the Midlands, prices which most certainly are considerably below cost. Rolling mills generally are clearing off orders rather faster than new ones are coming along to replace them; consequently the low level of prices already reached is not a hard and fast one, but will yield to the temptation of a good specification, such as occasionally comes into the market.

Effects of the London Settlement

Nevertheless, we think the general outlook, although not bright, is a little more favourable than it has been. The result of the London Conference on the Reparations question will have its effect on trade both here and on the Continent. The acceptance of the settlement by France and Germany will give us that peace—or an approach to it—for which Europe has been waiting so long. That in itself must be on the whole beneficial. It will restore some measure of confidence, which is the only atmosphere in which business can flourish.

The effect on the particular industry with which we are concerned is two-sided. Germany is pre-eminently a steel-making country, and if the agreement restores her economic position, which is one of the objects aimed at, then her steel works will get busy, and we shall see our share of reparations paid in part in steel, which we certainly do not want in this country. We shall be faced again with the old competition, but keener than ever before. On the other hand, we shall, to some extent, be relieved from the unfair and unnatural competition caused by the depreciated currencies. The French and Belgian exchanges have already recovered considerably, and will undoubtedly improve still further when the settlement has been ratified. Each step upward lessens the margin by which the French and Belgian steel makers can underquote us here; and it is from that side, not from Germany, that the English market has suffered for the past year or two. This movement has actually started. The inroads of continental material have been somewhat checked by the appreciation of the two exchanges. The rather sharp advance has caused the Belgian shippers to be chary of entering into fresh commitments until they can see the position more clearly.

There is evidence that our Government is getting apprehensive, as the recent reports have shown. The old 26 per cent. reparations duty on imports from Germany is to be reimposed on September 9. That does not amount to very much. The tax can be evaded without much difficulty by the Germans exporting their goods through other countries. If anything is to be done by way of protection it will need a more comprehensive scheme than that.

Problems at Home

The troubles with which the English works have to contend come not only from without, but are quite plentiful enough at home. The bad times through which we have been passing are beginning to tell on the workmen as well as on the employers, and there is more unrest about than one likes to see. The strike at Messrs. Hickman's works, although officially it is still in existence, has actually broken down, simply because the firm have filled the places of those who went out. Now a more serious trouble has broken out in South Yorkshire, where three of the most important steel works in the country, Messrs. Steel, Peech and Tozer; the Park Gate Iron and Steel Co., Ltd.; and Messrs. Samuel Fox and Co., Ltd., are completely shut down owing to the action of a small section of their men. The lower-paid men at these works may have had cause for complaint, but their case was under consideration, and negotiations were actively in progress on their behalf.

A settlement was finally reached with the Iron and Steel Trades Confederation, which is the largest union in the steel trade, and this settlement gave an appreciable advance to all the lower-paid men, irrespective of the unions to which they belonged. Unfortunately, a district joint committee had been formed by the various unions in Sheffield, which seemed determined to have a strike, and they actually called their men out three days after the settlement with the Confederation had been made. We have now the ridiculous position of the three works being shut down, and many thousands of men out of work owing to the strike action of a small number, who, if they returned to work, would straightway receive at least the advance for which they went out, and in some cases a little more. Such happenings as this make one doubtful about the future of the steel trade in this country.

Market Conditions

Turning to the market conditions during the month, there is not much that is cheerful to say. Pig iron has been very weak, and only the smallest amount of business has been done. The home demand is very limited, and the export market has been on the decline. The total shipments of Cleveland iron in July were only 32,524 tons, a decrease of 5,271 tons compared with June, and 31,688 tons less than in May. Prices have come down still further, a reduction of 2s. to 2s. 6d. per ton having been made since the beginning of the month. The production costs certainly have fallen owing to the lower price of coke, but this reduction, the makers assert, has long been discounted in the low price of the iron. Notwithstanding, consumers are not anxious to buy forward in any quantity; and it is doubtful if the makers would be willing to sell largely on the present low prices. The improvement in the franc exchange is bringing a little more foreign inquiry for Cleveland iron. There has been some buying recently in the Midlands, but not of sufficient amount to make an impression on the market.

The finished iron market is also uninspiring. Business is extremely flat, and although many of the works have closed down those remaining are not receiving anything like sufficient orders to keep them busy. The most satisfactory branch of this trade is marked bars, for which there is a fairly steady flow of orders at prices which should be profitable to the makers.

The steel market is no exception to the general rule. Orders are relatively scarce and prices weak. In the early part of the month the price of hard basic billets was reduced 10s. to 15s. per ton. This was no doubt due to underquoting resultant on the secession of one or two makers from the Association. Soft billets have also fallen. The billet trade has not been very good for the English maker recently, on account of the large purchases of continental billets which have been made not only by re-rollers but by some of the steel works, who find it necessary, even if not desirable, to work on the cheaper foreign material than on their own production.

Steel plates remain unchanged in price. The plate makers have this month had a meeting in London, at which it was decided to make no alteration at present. The official minimum prices, however, are not being strictly adhered to when definite orders are to be obtained. The recognised prices for small steel bars is £9 15s., which is also subject to the usual cutting. The re-rollers, working on continental billets, are too strong in this market to give the English makers much chance. Sections are being sold at £9 5s. to £9 7s. 6d., and even at this price there are not many orders to be had.

There has been some liveliness in the ferro-manganese market. The home price at the beginning of the month was £16; this was reduced to £15, and now the price stands at £13 10s. We believe this is a case of dissension amongst the associated makers. The Ferro-Manganese Association has

always been regarded as one of the most loyal of all price control associations, but the lean times have evidently proved too strong, and there has been a sudden break-out. Orders have been taken by some of the makers at as low as £13 5s., but we understand the association has now been reformed, and the official price remains at £13 10s.

Production Figures

The production figures for July are for pig iron, 611,800 tons compared with 607,800 in June and 655,100 in July, 1923; and for steel 693,300 tons, compared with 651,500 in June, when Whitsuntide holidays interfered with the output, and 639,500 tons in July, 1923. The number of blast furnaces working at the end of July was 174, which is 11 less than at the beginning of the month, and the lowest number since December, 1922.

There have been some large contracts placed from overseas, but not all of them have come to England. Out of 94 boilers required for various classes of locomotives by the Union of South Africa, only 32 have come to this country; the other 72 have been ordered on the Continent. The Crown Agent for the Colonies has placed orders with makers in this country for 38 locomotives of various types and 400 goods wagons.

Messrs. Guest, Keen and Nettlefolds, Ltd., are establishing a screw-making factory in Australia, on a site near Melbourne, from which they hope to cater for the requirements of the Australian market.

Some Inventions of the Month

By Our Patents Correspondent

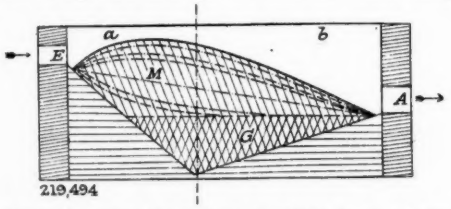
We give below a brief index to current articles in the technical press dealing with metallurgical subjects.

Aluminium Alloys

An invention for improving the structure of aluminium alloys has been patented by The British Aluminium Company, Ltd., A. G. C. Gwyer, and H. W. L. Phillips. Aluminium-silicon alloys containing 10–15 per cent. of silicon may have the silicon dispersed in the entectic, or in large crystals, while alloys containing less than 10 per cent. of silicon have it all in the entectic, and more or less dispersed. Greater dispersion improves the properties of the alloy. This dispersion of the silicon or "modification" of the alloy can be effected by adding an alkaline earth metal such as calcium, or a compound of an alkaline earth metal, preferably barium. As an example, an alloy consisting of 87 per cent. aluminium and 13 per cent. calcium is treated with 0·1 per cent. of calcium at 750° C. Other modifying agents which may also be employed are peroxides of an alkali or an alkaline earth, and also metallic antimony or magnesium. The patent specification gives an interesting theory of the action of these modifying agents, and also indicates the effect on the structure and properties of the metal. See Patent No. 219,346, dated January 22, 1923.

Smelting Furnaces

An oil or gas heated smelting furnace particularly suitable for the production of alloys and metallic phosphor compounds has been patented by P. Baumert of Leipzig-Plagwitz, Germany. The furnace has a flat horizontal roof and the gas or oil vapour is injected through the inlet *E*. The charge *M* is



219,494

laid to slope towards the outlet *A*, which is at a lower level, so that a narrow combustion space *a* is succeeded by an expanding zone *b* in which combustion is completed. An equalisation of temperature is thus obtained. A tapered space *G* is formed in the hearth where easily fusible materials can be protected by others from direct contact with the flame. See Patent No. 219,494, dated July 27, 1923.

Cast Iron

According to a patent application by the firm of H. Lanz, of Mannheim, Germany, chromium, nickel, or molybdenum are added to cast iron containing lamellar pearlite and fine uniformly distributed graphite. See application No. 217,885, having the International Convention date, June 23, 1923.

Recovering Tin

A dry process for recovering tin is the subject of an application by Société d'Electro-Chimie, d'Electro-Métallurgie, et des Aciéries Electriques d'Ugine, of Paris. Materials containing tin and iron, such as minerals, scoria, scrap, scum, hards and liquation products are treated during reduction with a substance such as silicon or ferro-silicon which alloys with the iron but not with the tin. On cooling, the tin separates from this alloy. See application No. 217,900, having the International Convention date, June 21, 1923.

Extracting Tin from Ores

A process for extracting tin from Bolivian ores which carry a considerable percentage of iron, antimony, lead, bismuth, copper, etc., has been patented by E. C. R. Marks, London (communicated by American Smelting and Refining Co. of New York). The ore may first be subjected to a pre-roasting or sintering operation to agglomerate it and to remove excess of sulphur, and sand or silicious flux may be added before sintering. The ore is then mixed with just sufficient coal or coke to reduce the bismuth, antimony, copper and other metals, but not the tin and iron, the latter being converted into stannous and ferrous oxides. Sufficient silica is also added to convert these oxides into a slag. The reduction is effected in a water-jacketed blast furnace. The slag containing silicates of iron and tin is separated from the metals, fluxed with lime, and mixed with coal or coke and reduced in a water jacketed blast furnace. Practically all the silicate of tin is reduced to the metal, and the iron with a small percentage of tin remains in the slag. The tin obtained is of very high purity. It is found that if sufficient silica flux is used, very little iron-tin alloy is formed in spite of the high temperature of the blast furnace.

Alloys

An aluminium-iron alloy has been patented by E. C. R. Marks, London (from Kemet Laboratories Company Inc., of New York). It is known that binary alloys of iron with about 9 per cent. of aluminium have a high electrical resistance and good heat resistivity, but are too brittle to be worked. It is now found that such an alloy may be rendered workable if 5 per cent. of a malleabilising component is added, preferably chromium or manganese. The carbon content must be less than 1 per cent., preferably less than 0·2 per cent. Examples are given in which the alloy contains 10–16 per cent. of aluminium, and up to 20 per cent. of chromium. These alloys have a remarkably high electrical resistance. See Patent No. 217,991, dated March 26, 1923.

Reorganisation of U.S. Bureau of Mines

The United States Bureau of Mines has been reorganised, and the divisions as rearranged include:—The Division of Mining Experiment Stations, with administrative control of various stations. The Division of Metallurgy, conducting researches in physics, chemistry, and engineering connected with the metallurgy, ore dressing, reduction and refining of the ferrous and major non-ferrous metals; specifically of iron, steel, copper, lead, zinc, aluminum, gold, silver and their alloys, will be under the direction of the chief metallurgist, who will have administrative charge of the field studies now being conducted at two of the experimental stations; at the Massachusetts Institute of Technology, and at the Bureau of Standards; together with the co-operative studies on oxygen enrichment of air blasts. There are also the Division of Mineral Technology, under the charge of the chief chemist, the Division of Fuels, under the chief mechanical engineer, the Division of Petroleum and Natural Gas, under the chief petroleum engineer, the Division of Mineral Leasing, the Division of Mining Research, the Safety Service, the Chief Surgeon's Office, the Chief Explosives Chemist's Office, and two administrative divisions.

Current Articles Worth Noting

We give below a brief index to current articles in the technical press dealing with metallurgical subjects.

ALLOYS.—The mechanical properties of aluminium-zinc alloys containing cadmium. N. F. Budgen. *J.S.C.I.*, August 15, 1924, pp. 273-276 T.

Properties and structure of some alloys of aluminium-copper-tellurium. F. T. Sisco and M. R. Whitmore. *J. Ind. Eng. Chem.*, August, 1924, pp. 838-841. Demonstrates that these alloys are of little practical value commercially.

Anti-friction bearing metals. A consideration of the chemical, thermal and physical characteristics of the tin-base alloys. P. W. Priestley. *Automobile Engineer*, August, 1924, pp. 225-230.

CORROSION.—The electrolytic theory of corrosion. W. D. Bancroft. *J. Phys. Chem.*, August, 1924, pp. 785-871. A comprehensive discussion of the results obtained by various investigators and a demonstration of the adequacy of the electrolytic theory as a satisfactory working hypothesis.

ZIRCONIUM.—Technology of zirconium and its compounds. F. C. Nonamaker. *Chem. Met. Eng.*, July 28, 1924, pp. 151-155. The separation, purification and chemical behaviour of the metal; the possible value of the metal as an alloying constituent and of the oxide as a refractory.

IRON AND STEEL.—The constitution of technical iron. F. Wever. *Z. Elektrochem.*, August, 1924, pp. 376-382 (in German). Considers the relations between the carbon content and the different polymorphous modifications of iron.

The mode of retention of nitrogen in electric arc weld metal. E. J. B. Willey. *J.S.C.I.*; Part I, August 1, 1924, pp. 263-266 T.; Part II, August 8, 1924, pp. 267-270 T. The presence of iron nitride and of a second nitrogenous compound is demonstrated; the undesirable characteristics of welds made by the electric arc process may be attributable thereto.

Pickling of iron and steel; a bibliography. V. S. Polansky. *Blast Furnace and Steel Plant*, August, 1924, pp. 368-371.

CHROMIUM.—Chromium—its uses and alloys. Part I. W. M. Mitchell. *Blast Furnace and Steel Plant*, August, 1924, pp. 372-375.

The preparation of pure chromium by the direct reduction of the oxide with hydrogen. W. Rohn. *Z. Metallkunde*, July, 1924, pp. 275-277 (in German).

ELECTRO-PLATING.—Studies on electro-plating. Part III. Addition agents (*concluded*). W. E. Hughes. *Metal Ind.* (*Lond.*), August 1, 1924, pp. 103-104. Theories uderlying the function and action of such agents.

Diseases of nickel deposits. W. Voss. *Metal Ind.* (*Lond.*), August 8, 1924, pp. 124-126. Tabulates symptoms, causes and cures.

Nickel anodes. T. B. L. Cain. *Metal Ind.* (*Lond.*), August 22, 1924, pp. 175-178. A review of some recent research on the efficiency of commercial nickels and the nfluence of various impurities.

ALUMINIUM.—The influence of cadmium upon the mechanical properties of aluminium. Part I. N. F. Budgen. *Metal Ind.* (*Lond.*), August 15, 1924, pp. 145-147.

NICKEL.—Mechanically perfect electrolytic nickel. C. P. Madsen. *Metal Ind.* (*N. York*), August, 1924, pp. 320-321. Methods of making ductile nickel electrolytically.

ANALYSIS.—The determination of carbon in aluminium. R. Hahn. *Metal Ind.* (*N. York*), August, 1924, pp. 318-319.

The estimation of copper and tin in copper-tin alloys. A. T. Etheridge. *Analyst*, August, 1924, pp. 371-374.

ORE SEPARATION.—Selective flotation as applied to Canadian ores. C. S. Parsons. *Canad. Chem. and Met.*, August, 1924, pp. 187-190. Oils and addition agents employed, with examples of separations obtained.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

ALUMINIUM CORPORATION, LTD., London, S.W.—Registered July 25, £5,000 mortgage, to W. Wagstaffe, Penn Cottage, Deganwy; charged on properties at Llanhetryncenin, etc. *£760,060. November 22, 1923.

BRITON FERRY STEEL CO., LTD.—Registered July 30, debenture, to bank; charged on properties at Briton Ferry, etc., also general charge. *Nil. June 14, 1923.

COOK (JOSEPH) SONS AND CO., LTD., Washington, ironfounders.—Registered July 25, £2,000 debenture, to Mrs. I. B. Cook, North Biddick Hall, Washington; general charge (subject to prior debentures). *£25,167. July 16, 1923.

COOPER AND HALL, LTD., London, E., steel manufacturers.—Registered August 9, £3,000 debentures (filed under section 93 (3) of the Companies Consolidation Act, 1908), present issue £2,000; general charge. *Nil. January 16, 1924.

FLEXILE METAL CO., LTD., London, N.—Registered July 28, £5,000 2nd debentures and £6,000 3rd debentures (filed under section 93 (3) of the Companies Consolidation Act, 1908), present issues £4,900 and £6,000; general charge. *£5,000. June 20, 1924.

HASSALL AND SINGLETON, LTD., Birmingham, ironfounders.—Registered August 5, £2,000 debenture, to Mrs. L. L. Sampson, Clinton Terrace, Derby Road, Nottingham; general charge. *£1,500. August 10, 1923.

MINNA (NIGERIA) TIN CO. (1914), LTD., London, E.C.—Registered August 8, £250 debenture, to C. R. Enever, Broad Street House, E.C., solicitor; general charge. *——. January 11, 1924.

NINETEEN NINETEEN METAL CO., LTD., Birmingham.—Registered July 23, mortgage, to bank; charged on certain book debts amounting to £1,000 8s. 1d.

UNITED STEEL COMPANIES, LTD., Sheffield. Registered July 23, mortgage, to bank; charged on premises, plant, etc., at Wellingborough, purchased by company from Thos. Butlin and Co., Ltd. *£2,427,798. October 22, 1923.

Satisfactions

FLEXILE METAL CO., LTD., London, N.—Satisfaction registered July 28, £5,000 (not ex.), registered March 2, 1921.

JONAS AND COLVER, LTD. (late SIR JOSEPH JONAS, COLVER AND CO., LTD., and JONAS AND COLVER, LTD.), Sheffield, steel manufacturers.—Satisfaction registered July 25, £47,100, registered October 21, 1912.

RICHARDS (W.) AND SONS, LTD., Middlesbrough, iron and steel manufacturers.—Satisfaction registered August 6, £4,000, registered August 15, 1904.

WILSON (CHARLES), LTD., Sheffield, ironfounders.—Satisfaction registered July 26, £500, registered September 11, 1917.

U.S. Electric Furnace Production

THE production of steel by electric furnaces in the United States is increasing at a remarkable rate, and new high records were established in several branches of the industry last year. Steel castings from electric furnaces in 1923 amounted in all to 235,958 tons, an increase of more than 50 per cent. over the previous record, made in 1920, while 10 years ago electric steel casting amounted to less than 1 per cent. of the country's output. Alloy steel casting from electric furnaces also broke all records in 1923, with a total of 29,054 tons. This is an increase of 64 per cent. over the previous high mark of 17,760 tons, made in 1922.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

Acid-resisting Iron for Nitric Acid Plant

By S. J. Tungay

The author, a well-known practical authority on the subject, describes the advantages of iron silicon alloys for the construction of nitric acid plant, and discusses the modern tendency to favour units of moderate size, particularly for use in India and the Far East.

DURING recent years there has been a considerable change over in the method of construction of nitric acid plant, both in Europe and in America. In the past, pottery and glass were regarded as practically the only media for the construction of plant and apparatus for the production of nitric acid commercially; much of the plant, however, as designed in pottery, was found to be more or less cumbersome. It was found to occupy considerable space and the material of construction proved a source of many breakdowns, with consequent loss and annoyance.

Until a few years ago large installations of stoneware pipes and bottles or tourills were to be seen at most of the works producing nitric acid; and the drawbacks of pottery or stoneware, for dealing with gases and liquids subject to continual variations of heat and cold, are well known. Pipes were always liable to breakage from expansion and contraction, joints were awkward and prone to leakage, and as inevitably happens, troubles of this kind usually occurred at the most important period when a charge was being put through the plant.

Modern Iron Silicon Alloys

The development of acid-resisting iron in the form of iron silicon alloys such as "Ironac," "Tantiron," "Duriron," and the like has opened up entirely new and different methods of construction with regard to nitric acid plant.

It is remarkable that while for many years lead has been the metal which is the recognised medium for the construction of plant producing sulphuric acid, for long years there had been no satisfactory metal which could be used in a like manner for the production of nitric acid until the advent of these high silicon irons; and it is quite evident, from the very widespread manner in which nitric acid plant has been designed and installed in ferro-silicon, that this metal has come to stay, and is already the recognised form of metallic construction for use in connection with nitric acid.

As the figures in the next column indicate, its passivity towards nitric acid is remarkable, and it is well known that, with a pure form of iron having a silicon content of 13 to 15 per cent., there is practically no perceptive corrosion with nitric acid or nitrous gases.

CORROSION TESTS ON "IRONAC" ACID-RESISTING IRON. TEST PIECES SELECTED OFF WORKS PLANT.

Acid.	Initial weight	Loss after boiling at 150° for:		
	grams.	24 hrs.	48 hrs.	72 hrs.
Nitric acid 30%	116·629	0·013	0·016	0·016
Nitric acid 90%	13·392	0·011	0·038	0·074

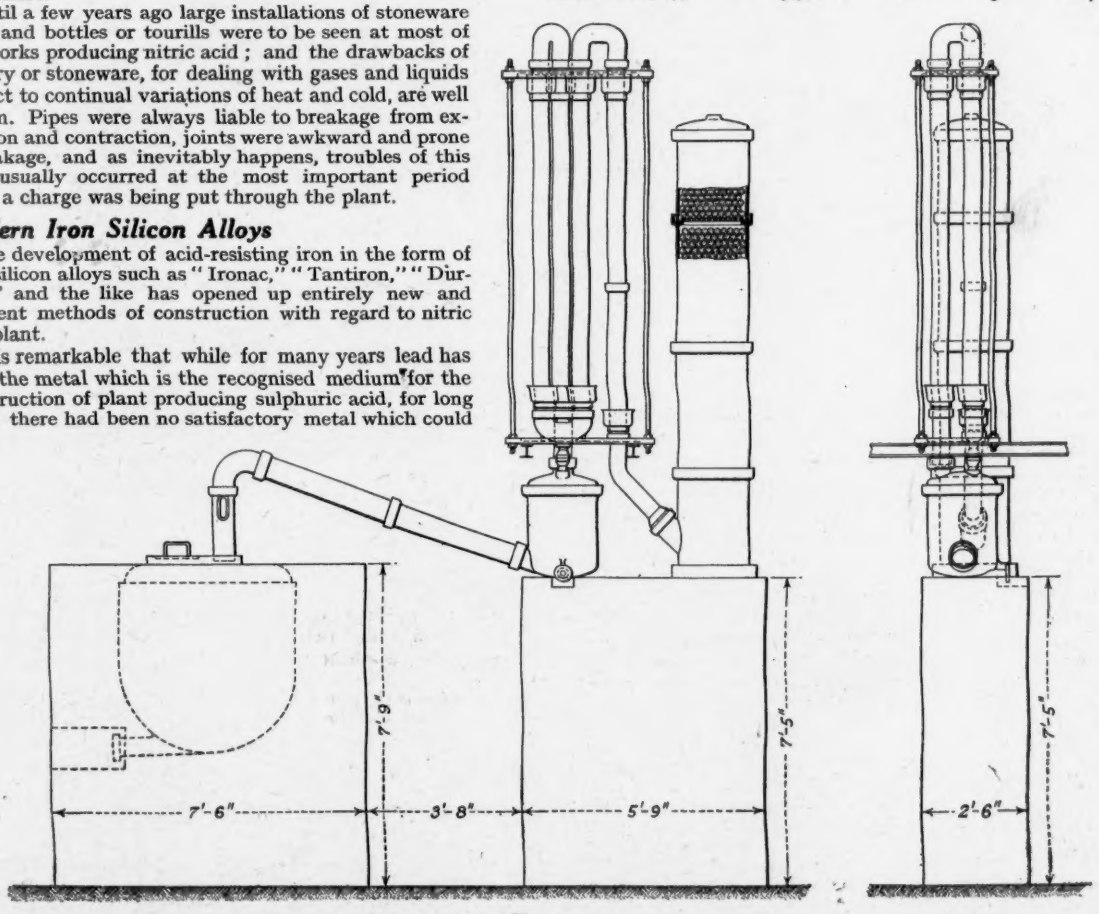


FIG. 1.

Not only has the advent of a satisfactory acid-resisting metal for nitric acid manufacture largely displaced pottery, but it has enabled the installation of plant to be arranged in a much more compact manner, occupying far less floor space. Its adoption has also resulted, where applied to some types of plant, in producing a larger proportion of strong acid, say, of 96 per cent., than was formerly obtainable in the old system.

Again, nitric acid plant constructed of metal is far more suitable for water cooling; consequently the condensation is effected in much less time than by the older installations, where air-cooled types of condensers were often utilised. Another point in favour of the metal construction is the greater heat conductivity of acid-resisting iron as compared with stoneware. This results in the fact that a considerably lesser area of condensation pipes or vessels is needed than was formerly the case.

Demand for Small Plants

During the war period many large and important installations of nitric acid condensation were carried out in acid-resisting iron for the British and Allied Governments. These plants were very imposing and produced remarkably good results. The present article, however, is intended to bring out more particularly the post-war application of acid-resisting iron for nitric acid.

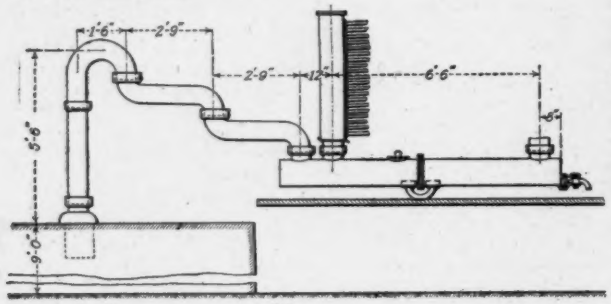


FIG. 2.

More recently there is a great tendency on the part of users of nitric acid to put down small units of manufacture and condensation rather than to purchase acid from the larger manufacturers, and thus avoid the present high cost of freightage and transport. This more particularly applies in India and the Far East, where supplies are not easily and readily available and where transport charges are costly.

It is perhaps only to be expected that there has consequently been a wider demand for small installations of nitric acid plant, and it is in this particular connection that acid-resisting ferro-silicons have again shown their usefulness. The installation of small units abroad and in outlying parts, when made of pottery and fragile material, was fraught with continued difficulty; but now that we have a suitable type of metal construction at hand, many of the former disadvantages have disappeared.

When considering the application of condensation for small units of nitric acid it has been found desirable to depart somewhat from the methods adopted for the larger installations of plant.

Fig. 1 shows a form of nitric acid plant designed for erection in the East. It has a vertical condensing unit so arranged that the entire system occupies but very little floor space, even including the space occupied by a final absorption tower. This plant was designed for use in India, being coupled to a small retort and suitable for producing, say, 5 cwt. of nitric acid per day. The entire condensing unit, from the still uptake, is constructed of " Ironac " acid-resisting iron.

The vertical tubes are water cooled, being irrigated with a film of cold water discharged from cups at the top of the condensing pipes, received by collecting cups at the bottom of each pipe, and used over and over again for cooling; this being necessary in localities where water may be at a premium.

It will be seen that a small unit arranged in this way is essentially simple, and can be easily operated and maintained by native labour, every part being extremely easy of access. With an arrangement of this kind in a hot climate, the gases have a long traverse before reaching the final absorption tower; and as the hot gases are so arranged as to pass through the collecting vessel, this results in effectively bleaching the acid, so that a nitric acid is produced of 96 per cent. strength and of good colour.

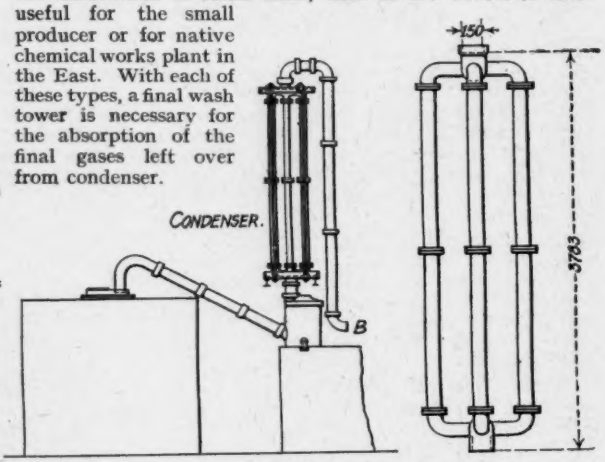
Where a somewhat larger output is required, a modification of the well-known Hart type of condenser has found much favour, this being arranged as in Fig. 2.

This system again is constructed entirely of acid-resisting iron, small diameter horizontal tubes which are connected to the header No. 15, being irrigated by a water sprinkling arrangement fixed overhead. The condensed acid is collected and trapped into a horizontal receiver, and drawn off by a tap No. 20 at the end. This system again permits of the manufacture of a very regular quality. A large proportion of the acid is condensed in the "S" pipe bends, between the still uptake and the condenser.

Another very useful nitric acid condenser for small output, which has been constructed in acid-resisting iron, is shown as Fig. 3.

The gases from the still pass through a receiver and bleacher into a condenser which consists of four vertical pipes, with distributing arms arranged at top and bottom. This arrangement has also been found quite satisfactory in cold weather and cold climates, even though air-cooled; but it has the advantage also that a water-cooling device can be arranged for hot weather, so as to ensure the maximum condensation of the gases.

This is again a type of plant which lends itself peculiarly for the installation of small units, such as are doubtless most useful for the small producer or for native chemical works plant in the East. With each of these types, a final wash tower is necessary for the absorption of the final gases left over from condenser.



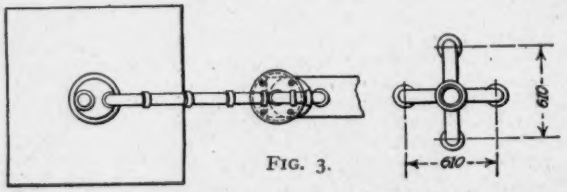


FIG. 3.

These towers are again constructed, as in Fig. 1, entirely of ferro-silicon iron, thus entirely obviating the use of pottery, and the danger of unexpected fracture of bends and vessels, which was formerly the nightmare of the nitric acid maker. Many manufacturers of nitric acid latterly give preference to a condenser constructed of " S " bends, similar to the arrangement as shown in Fig. 4.

This is quite a good system, as it will be seen that there are but very few parts, and these being, with few exceptions, duplicates of one another, a very decided advantage with this type is that the capacity of the condenser can be increased with facility by adding a few more pipes to the unit. The replacement of any piece, should the necessity arise, can be accomplished with facility. This is also of similar construction, but on a smaller scale, to that of many of the large nitric acid-condensing plants that were erected for the war-time production of this acid.

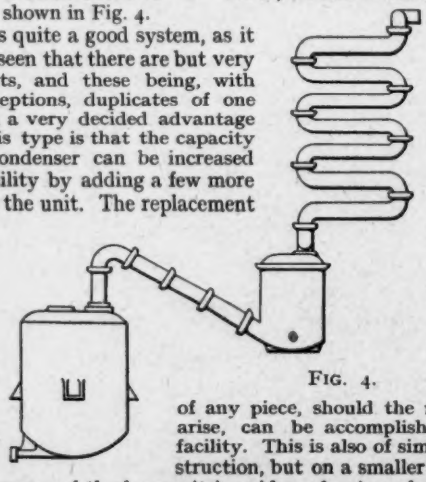


FIG. 4.

Do Small Plants Pay?

It may be argued by some whether these very small units are a paying proposition. This, of course, will depend upon local conditions—the facility of obtaining raw material, such as sodium nitrate and H_2SO_4, and the cost of transport. On the other hand, there are some of the larger producers of nitric acid on the Continent who still maintain that they prefer a number of small units for the manufacture of nitric acid rather than an installation of 1 or 2 units of a much larger capacity.

In his work on the *Absorption of Nitrous Gases*, H. W. Webb* has pointed out conclusively the very important advance that has been made since the introduction of ferro-silicon irons to the construction of nitric acid plant; and no less an authority than Zeisberg of the E. I. du Pont de Nemours Company, in a lecture given at the Carnegie Institute, Pittsburg, in March last, stated clearly that silicon iron plant is being more extensively used in America.

Acid-resiting iron has a special application for condensers and towers of synthetic nitric acid plant, either derived from the ammonia oxidation process or from atmospheric nitrogen; as where very large quantities of dilute nitric acid are to be concentrated to an acid of commercial strength or even to a higher concentration, plant consisting of acid-resisting metal has been proved extremely advantageous.

There has also been very much plant erected in acid-resiting iron to deal with the recovery of nitrous gases from processes involving the use of nitric acid and of mixed acids; and for denitration plant, towers of various forms of construction are being regularly and most successfully built in metal. Here, again, it is not only a question of acid resistance, but also heat reistance, which results in a metal construction being so much more suitable and efficient than stoneware or pottery.

The entire chemical industry is watching with great interest the development of plant constructed in metal for nitric acid. More extensive details of these metals are given in the work now in progress on "Acid-resisting Metals" which forms one of the series of the Chemical Engineering Library to be published by Ernest Benn, Ltd.

Control in Case-Hardening

INFORMATIVE booklets issued by commercial concerns are on the increase though still something of a rarity. Automatic and Electric Furnaces, Ltd., of Elecfurn Works, of 173-175, Farringdon Road, London, E.C.1, the makers of the Wild-Barfield furnaces, produce a number of excellent little leaflets which are full of instructive information. The latest of these is entitled "Output," and deals with the subject of obtaining the correct temperature in hardening steel. This is usually done by maintaining the furnace at the required temperature of 750° C., as indicated by a pyrometer, and allowing time for the steel to reach the proper temperature. A diagram published in the leaflet referred to, obtained by plotting measurements obtained with a thermo-couple in the steel, shows that this may take a considerable time, while to ensure that the sample actually reaches the temperature desired it is in practice left in the furnace longer than is actually necessary, because it is of course not possible to have a thermo-couple in the metal in actual use. This leads to a waste of time and consequent increase in cost.

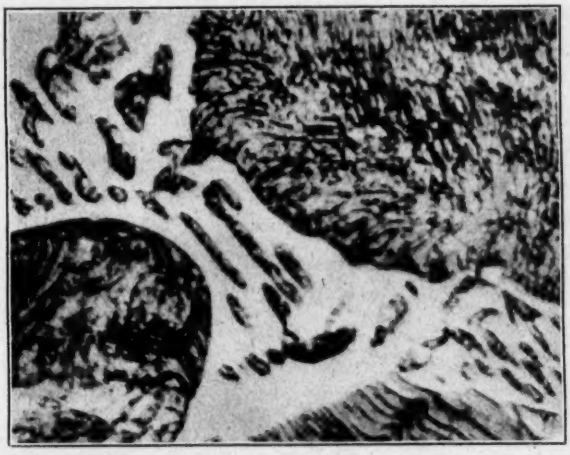
The difficulty of knowing when the steel has reached the required temperature for quenching may be overcome by making use of the fact that it is just at this temperature that the steel loses its magnetic properties. If a non-magnetic indicator is fitted to the furnace, the working temperature may be higher so that the steel heats up more quickly. A diagram reproduced in the leaflet already referred to shows that the transformation temperature was reached in 7½ minutes as against 33 minutes with the cooler furnace. At this point the magnetism falls to zero, and the temperature of the steel commences to rise rapidly again if it is not removed, showing that the disappearance of the magnetism indicates the completion of the transition stage. The diagram indicates clearly that the non-magnetic indicator not only shows the completion of the transformation, but also allows the time of heating to be safely reduced to one quarter, allowing a speeding up of the work by four times, the furnace temperature being about 875°C., instead of 750°C.

*H. W. Webb. *Absorption of Nitrous Gases*, 1923.

Photo-Micrograph of Cast Iron

To the Editor of THE CHEMICAL AGE.

SIR,—The accompanying photo-micrograph shows the phosphide eutectic in a grey cast iron at 5,000 diameters. This shows that the constituent which appears as dark markings at × 1,000, and is commonly described as iron carbide, is actually duplex, and in fact very similar to pearlite, consisting of alternate laminæ of iron carbide and iron. It is recognised from the research of Stead that there would be present the three constituents of the triple eutectic, namely, iron phosphide, iron carbide, and austenite, or their transformation products. Thus the presence of laminated pearlite, from the transformation of



PHOTOGRAPH OF CAST IRON, ILLUSTRATING THE NATURE OF THE PHOSPHIDE EUTECTIC: TAKEN ORIGINALLY AT ×5,000, REDUCED ON REPRODUCTION TO ×3,000.

austenite, is accounted for. The pearlite thus associated structurally within the phosphide eutectic masses may conceivably be richer (it probably is, but may even be poorer) in carbon content that obtains in the normal pearlite ratio, ratio, Fe_3C 21 Fe. Professor Desch, to whom I have shown several similar photographs, confirms the foregoing explanation. I am not aware that attention has previously been called to the pearlitic structure of this constituent. The photograph was taken at 5,000 diameters by means of the super-microscope.—Yours, etc.,

F. ROGERS.

5, Hicks Lane, Westbar, Sheffield.

Progress in Hardness Testing

AT the International Steel Exposition held in Boston recently a committee of the U.S.A. National Research Council conducted a symposium on hardness testing. One of the topics of discussion was the old question as to the meaning of any given hardness number, and the problem of ascertaining the fundamental properties of a metal that determine such "practical properties" as, for instance, machinability under given conditions or resistance to a given type of abrasion. The problem of testing hardness scientifically is still far from complete solution, but real progress is being made (*Chemical and Metallurgical Engineering* states); it is now recognised almost generally that any hardness test measures a property that is the resultant of several more fundamental properties, and that any "practical property" which we wish to determine is also the resultant of several fundamental properties.

A test that is proving to be of assistance is one that is not ordinarily considered a hardness test, but one that helps us to interpret the results obtained from the usual hardness tests. It is the notched bar impact test, in which a bar of metal is broken and the energy consumed measured. With proper procedure, figures can be obtained that show promise of being truly indicative of important fundamental qualities of the metal. There begins to appear a dim picture of the probable eventual solution of the hardness testing problem: a group of hardness tests of different kinds giving us a set of simultaneous equations, the solution of which will produce the fundamental figures to be fitted together to provide an accurate indication of the "practical property" in which we are interested.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Hardening of Steel

DESPITE the enormous literature of the subject, it may be doubted whether the ultimate causes of the hardening of steel are really known. Theories abound, but practice, even when systematised and "scientifically controlled," remains to a large extent empirical. In carbon steels a certain minimum of carbon must, theoretically, be present, yet, to some extent, it has been known for years past that even dead soft steels have *some* capacity for hardening. Experiments lately undertaken at Creusot have shown that when such steel is quenched at very high temperatures it becomes much harder than when quenched at normal temperatures. Dead soft open-hearth steel and an Armco iron were used in the tests, and the composition of the specimens is shown below: —

	O.H. Steel.	Armco iron
Carbon	0·090	0·064
Silicon	0·033	0·044
Sulphur	0·022	0·027
Phosphorus	0·008	0·029
Manganese	0·330	0·065
Copper	0·110	Nil

In the case of the dead soft steel, the ball hardness results when quenching were carried out at a temperature varying from 950° to 1,350° C. show an insignificant amount of hardening, but above 1,400°, and more particularly in the vicinity of 1,450°, all the mechanical properties alter suddenly. Further experiments were conducted on other samples of open hearth steel, on Swedish steel, and on wrought iron. The results show that even a dead soft steel can be considerably hardened. The temperature to which it must be heated varies between the fusion point of nickel and the fusion point of dead soft steel — that is to say, between 1,450° and 1,470°C. It might, *a priori*, be imagined that the hardening was due to a new critical point, but this was not borne out by the microstructure, which presented all the characters of normal martensite, while the changes resulting from annealing appear to be of the same nature as those which occur in more highly carburised hardened steels. The observed phenomena appear merely to indicate that the ordinary laws of hardening extend to mild steel in certain conditions. The critical temperature of hardening which, in the case of steel containing more than 0·3 per cent. of carbon, coincides with the point Ac3 or is a little higher, rises in the case of dead soft steel to the neighbourhood of the melting point, leading to the formation of a structure which is wholly martensitic, and shows neither troostite nor sorbite. In proportion as the carbon percentage in steel diminishes, and it approximates to pure iron, the critical temperature of hardening rises. Further experiments are to be undertaken to elucidate some of the points which still remain obscure.

Oxygen in the Blast Furnace

EXPERIMENTS have from time to time been made in the use of superoxygenated blast for blast furnaces, but no one has, as yet, come forward with any definite information as to the results which can actually be attained in practice. Attempts have been made on the Continent, particularly in Belgium, and some years ago a communication was read before a meeting of the Iron and Steel Institute on the subject, but the details given were meagre. Of late, however, there have been several articles published in the Continental technical press dealing, from a purely theoretical point of view, with oxygen in the blast. Siegle, whose mathematical work on blast furnace problems is well known, has tackled the problem of what is really likely to happen when the oxygen content of the blast is artificially increased. Apparently, from a practical point of view, there will be nothing to gain in having more than 26 per cent. of oxygen present in the blast. With this amount an economy corresponding with 100 kilogrammes of pure carbon could be obtained. Pure oxygen introduced with the blast does not increase the number of calories available, as is the case with ordinary hot blast, and with dry blast, and the economy resulting from the addition of a little oxygen is to be explained by the fact that the CO_2/CO ratio is raised to the highest point compatible with chemical equilibrium, that is to say, to the upper limit of the effective utilisation of the carbon. The potential heat of the gases is reduced, and this diminution added to the reduced sensible heat resulting from the impoverishment of the gas by nitrogen suffices to explain the gain. The addition of a small amount of oxygen to the blast, although tending to appreciable fuel economy, will have, as its predominant effect, an increase in the furnace productivity, and it is from this point of view that experiments in super-oxygenation of the blast should be undertaken.

Alloy Steels and Economy

ALLOY steels are more expensive than ordinary or "plain carbon steels." The kind of chromium steel used in the manufacture of stainless steel, for instance, is more than expensive; it is costly. Hence, the use of an alloy steel for any given purpose becomes an economic rather than a metallurgical question. In its simplest terms it may be said that if a given alloy steel costs three times as much as a normal steel, but lasts five times as long, it will, ordinarily, be a sound proposition, economically, to employ it. Naturally, some alloy steels are dearer than others, the alloying metal or metalloid being scarce. On the other hand, the process by which an alloy steel is made, even when the alloying agent is comparatively cheap, may in itself be costly to carry out. In no instance is economy more desirable than in the case of steel rails, and the question of durability is one which has often been discussed at Railway Congresses, the more so as the "load on axles" is becoming heavier and heavier and so accentuating the problem of wear and the difficulties in maintaining the permanent way. Such progress as has been made in steel rails during the last few years has been in the direction of increasing the section and improving the chemical composition of the metal and its method of heat treatment. Increasing the section has not proved satisfactory, but the addition of alloy metals to the steels has had better results. In America titanium has been used, but the so-called titanium steel rails do not contain any of that element, which is really added solely as a deoxidiser. Nickel steel rails are too costly, but manganese steel rails are currently used. High carbon steel rails are too brittle, and high silicon steel rails suffer from the same disadvantage, although in certain circumstances silicon can with advantage be added, provided the carbon be kept low. The process of heat treatment is important, but the problem is complicated by the fact that a rail requires to be hardened in order to prevent wear, and yet not hardened sufficiently to render it brittle. The various factors which have to be taken into consideration are grain-size and structure. The experience gained during the war in the manufacture of steel shells has thrown considerable light on the structure suitable for metal intended for rails. In this connection the Sandberg process has yielded very satisfactory results. Such rails have a sorbitic structure, and are now being very largely employed. A further advantage of the process is that it can be readily applied in the existing plant, and does not need the installation of special mills.

Surface Blowholes in Steel

SOME investigations on this subject have of late been carried out in Russia, where, in spite of the conditions prevailing, metallurgical research is still being carried out, and the spirit of Tschernoff continues to animate the small group of his devoted followers. While the reasons which lead to the formation of pipes in steel ingots are fairly clear, those relating to the formation of surface blowholes are not as yet satisfactory. Such blowholes arise in a wild steel when the occluded gases escape during solidification. The extent to which they do so is related to the percentage of silicon in the steel, or, in other words, to the methods of deoxidation employed during the manufacture. Such blowholes are not, however, peculiar to wild steel, but are also found on the exterior of dead melted steel. They are even larger in proportion as the size of the ingot increases. It is probable, however, that the blowholes observed in the case of wild steel and those which occur with steel which has been quiet in the ladle arise from different causes. The latter may often be due to the air which is introduced in the stream of molten metal, the surface tension of which is such as to offer considerable affinity for air, which is subsequently entangled in the mass of the steel, and escapes

on the surface. When ingots gassed in this way are subjected to compression as in the Whitworth process, the exterior blowholes are suppressed, for the zone which would otherwise contain them becomes redissolved while the mould is being filled. This dissolution of the exterior crust is accompanied with a boiling action, which takes place in contact with the walls of the ingot mould. The material of which the latter is made appears to have considerable influence on the depth at which exterior blowholes can be found, particularly when the steel is wild, and, generally speaking, the effect of the mould on the rate of cooling likewise exerts its influence. It is possible that on shrinkage part of the gases which have been imprisoned in the pipe find their way to the surface.

New Experimental Blast Furnace

A NEW experimental iron blast furnace, which embodies all the best features determined by observation of the performance of other furnaces, has been completed and blown in at the Minneapolis Experimental Station of the Bureau of Mines. The new experimental furnace is larger than the one constructed at Minneapolis last year. It is expected that metallurgical studies made possible by the construction of the new blast furnace will reveal valuable information relative to the production of spiegel iron from manganiferous iron ores, which cannot be smelted under present practice. Since the United States has tremendous reserves of these manganiferous iron ores, the problem of their successful smelting is one of great importance to the iron industry. The present furnace, which was erected in co-operation with the University of Minnesota, is 36 inches in diameter at the hearth and 30 feet high. The first run lasted 10 days. Air was supplied to the furnace at the rate of about 600 cu. ft. per minute, consuming approximately 8 tons of coke per day. From 15 to 20 tons of spiegel iron of varying manganese content was produced during the experiments. Several hundred gas samples were taken from the interior of the furnace shaft by means of water-cooled sample tubes.

Complete Gas Survey

THE most striking feature of the furnace experiment, in contrast with previous ones, lies in the fact that a rather complete survey of the composition of the gas stream in the furnace shaft was possible. By introducing water-cooled sample tubes through various test-holes, it was possible to cover completely six planes. As early as 1839 Bunsen determined the composition of the gas in the blast furnace at various elevations from the tuyere to the stock line. His results have been duplicated in a dozen or more investigations. In all this research samples were taken from only one point in each horiozntal plane. During the thirty-fourth and thirty-fifth runs with the Bureau of Mines furnace over one thousand gas samples were taken at five elevations in the furnace shaft. These samples, however, all lay along a single diameter of the furnace section. The necessity of sampling over a complete section has long been recognised, but the difficulty of obtaining such samples in practice has hitherto not been overcome. A study of the analyses of the samples of raw materials, slag and metal taken during the run, as well as the samples of gas removed from the charge column within the furnace, should throw considerable light upon the mechanism of the gas reactions taking place within the blast furnace shaft, and should result in the obtaining of much valuable information relative to the production of spiegeleisen from manganiferous iron ores.

The Fatigue of Metals

A NUMBER of interesting facts relating to the fatigue of iron and steel have just been published by Professors H. F. Moore and T. M. Jasper in the third portion of their extensive research in Bulletin No. 142 of the Engineering Experiment Station of the University of Illinois. On re-testing wrought specimens of iron and steel which have been subjected to many millions of stress alternations without failure, it is found that their endurance has been increased, the strengthening effect being greatest in those steels which are most hardened by cold-working. The static strength is also increased. Alternating stress above the endurance limit, on the other hand, weakens the metal, although the bad effect may be partly removed by polishing. Reversed axial stresses give an endurance limit which is only about 64 per cent. of that found by alternating bending tests, but this difference has not always been found by other investigators, and may perhaps be due to the form of test-piece employed. The authors consider that their test-piece represents the conditions likely to occur in the actual running of machines, and therefore recommend the adoption of the lower figure for reversed axial stresses. Steels give inferior tests across the direction of rolling, as would be expected, and it is interesting to note that the cross tests are more improved by heat treatment than the longitudinal tests. It is doubtful whether soft non-ferrous metals and alloys have an endurance limit, and in order to determine this point it will be necessary to continue the tests for hundreds of millions of cycles. The authors take the view that fatigue failures do not take place by slip, but by the tearing apart of minute portions of crystals and spreading of the fissures so formed.

Wrought Iron Direct from Ore

THE first series of tests on the Bourcoud process for the production on a commercial scale of wrought iron direct from the ore have been completed, and are stated to be satisfactory. Many processes to achieve this result have been attempted, but so far few have given promise of commercial practicability. The Bourcoud method is based on reduction by gas, though it does not resemble in any way the present methods of steel manufacture, the theory having as its foundation gas reduction as accomplished in the blast furnace. Should this process become a commercial practicability, as the present tests seem to promise, the blast furnace and the open hearth and Bessemer converter would be unnecessary. Any fuel can be used, including oil. The first complete installation on a commercial scale is being made at the River Rouge works of the Ford Motor Company, where it is proposed to use powdered coal as fuel.

Corrosion-Resisting Steels of High Strength

THE Krupp Company have evolved two steels which are high in corrosion-resisting properties and strength. The first is a martensitic steel of the following composition :—Carbon, 0·15 per cent. ; chromium, 14 per cent. ; and nickel, 1·8 per cent. The second is an austenitic steel of carbon, 0·25 per cent. ; chromium, 20 per cent. ; and nickel, 7 per cent. These two steels were exposed to atmosphere, salt water, 50 per cent. boiling nitric acid, and 10 per cent. nitric acid, and it was found that the corrosion, particularly of the austenitic steel, was from one-hundredth to one-tenth, or below the figure for ingot iron. The higher chromium steel gave only slight loss in sea water, and none at all in air or on exposure to nitric acid. The strength of these steels ranges from 90,000 to 130,000 lb. per sq. in. ultimate tensile strength, with 64,000 to 100,000 yield point for the martensitic and 42,500 to 54,000 for the austenitic steel ; the elongation of the martensitic steel was 12 to 22 per cent., and that for the austenitic 50 per cent. The resistance to wear of both steels averaged that of 12 per cent. manganese steel ; their hardness and toughness are high, and they are readily welded by gas flame or electric arc.

High-Chromium Iron

RECENT tests on high-chromium irons have revealed some information of interest regarding casting and machining. The tests were carried out on iron alloys with 25 to 30 per cent. chromium, 1 per cent. silicon and manganese, and carbon from 0·1 to 3 per cent. Alloys of this type are all found to cast well, though those containing more than 1·5 per cent. carbon do not machine so well as those below that figure, all the castings being very tough. The alloys have all satisfactory rolling, pressing, and forging qualities, and even those with high carbon content (not over 3 per cent.), are machineable after suitable heat treatment. As might be expected, the resistance to oxidation is high, and is apparently in direct ratio to the chromium content. The alloys above 20 per cent. chromium have good oxidation-resisting properties, and those with 27 per cent. chromium remain unaffected when exposed to oxidation at 2,000° F. At these temperatures the metal acquires a tough skin of oxide which protects against further oxidation, and also resists flaking. Sulphur gases do not affect this alloy range up to 1,800° F. In addition the alloys have important corrosion-resisting properties, and are unaffected by organic acids and nitric acid. The tensile strength varies with the carbon content ; when this is low, the elasticity is between 45,000 and 70,000 lb., and the tensile strength varies from 75,000 to 90,000 lb. per square inch, the ductility ranging up to 35 per cent. Alloys with a higher carbon content show a lower ductility and a higher hardness.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

It is to be feared that the expectations of an autumn revival in the steel trade are not to be realised. Up to the present there are no signs of it. We have now reached the end of September and the position is about as gloomy as it has been all the summer. There is no increase in the weight of orders, rather the contrary, and prices, where they have moved at all, have fallen. In every district the story is the same. It is, indeed, difficult to find anything cheerful to say.

Some optimists try to cheer themselves by saying that prices have reached the bottom. It would not be incorrect to say that they have gone through the bottom, if they are to be judged by the costs of production. The steel maker, unlike the engineer, cannot fix his selling price on the basis of his production costs. The market fixes the price, and the steel maker has to try to keep the cost below that figure. It is a hopeless endeavour just now, and has been for some time past, so far as the general trade is concerned. The published accounts of many important concerns have borne eloquent testimony to that.

There would certainly be some satisfaction in knowing that prices were as low as they were likely to get, but it only needs a good order to come into the market to show that this lowest level is a very variable quantity. And low as the present prices are they are still so much in excess of the foreign quotations that business is not likely to flourish until the two come into somewhat closer approximation. How that is going to be achieved is a problem. The position of the French and Belgian exchange is a hindrance, and on our side the burden of taxation, transport charges, and fuel cost is much too heavy.

The prices actually quoted from the Continent are altogether too low for the English makers to look at. A difference of between 40s. and 50s. per ton cannot be bridged. Notwithstanding this difference, the amount of buying even of Continental material is very small. The re-rollers are probably doing most in this line, but the stocks of billets and blooms which they hold will last a considerable time.

An Uncaptured Market

Fortunately, there is an important market in this country which the foreign manufacturers do not seem able to capture, a market which requires steel of established reputation and uniform quality. That is where the English steel maker is able to hold his own, and it is that market which offers him some chance of making ends meet. It is an accepted fact that in works the larger the output the less is the cost of production per ton; and in the common steels, for which no special quality is required, output is the chief factor in making the trade worth while. But in what might be called the quality steels the prices obtainable remove the necessity of making output the all-important point, and it is to this class of trade to-day that the steel maker must look to enable him to keep his head above water.

It is a good thing, therefore, that many branches of these special trades are not experiencing the general slump. The motor industry continues to be active, and from that source there is a steady flow of orders to the steel works, and of an appreciable volume. Some of the engineering trades are fairly busy; the textile machinery makers are not bad customers to the steel works just now. The large orders which have recently been placed in this country for locomotives will be welcomed, particularly by those works which are fortunate enough to secure the contracts for the steel materials required. The wagon building trade is also good, and it is expected that further good orders for new wagons will be placed in the near future.

Market Conditions

During the month there has been some fluctuation in the tone of the market. A brighter note has crept in on one or two occasions, but only to be followed by the usual dulness. There seem to be small spurts at times, but it requires more than these to set in motion a real revival. More than three-fourths of the blast furnaces in the Midlands are closed down, and in the North Lancashire and Cumberland district only one-third of the normal number of furnaces are at work. The North Lincolnshire Iron Co., at Frodingham, have damped down the only two furnaces they had in blast, and the Trent Iron Co. in the same district are about to close down their works. It is clear, therefore, that as far as the pig iron trade is concerned there is a long way to go before a satisfactory condition can be reached. Pig iron prices are very weak, with little business moving, and those furnaces which are working are finding it very difficult to prevent stocks from accumulating, although outputs have been reduced as far as is possible without interfering with the safe working of the furnaces.

One piece of good news to the blast furnace owners is the announcement of a further reduction in the price of coke, which has fallen 3s. 9d. per ton. This brings the price well below 20s., even for the better qualities. Already the pig iron consumers are claiming the benefit of this reduction by demanding lower prices for the iron, and it remains to be seen how far the makers will be able to resist this demand. They are justified in resisting it, as there has been no profit in recent selling prices.

Conditions in the finished steel market are unchanged. Prices for plates and sections are about the same, always with the possibility of slight reductions where good orders are put up for competition. The reduction in the cost of steel consequent on the cheaper coke has come at an opportune moment, as the recent increases in wages which have been given to all the lower paid men throughout most of the works in England and Scotland will mean an addition of 3s. or 4s. per ton on the cost of the finished products.

The strike at the three steel works in South Yorkshire still goes on, against the will of the majority of the men. They know that the wages which are now established will more than meet their original demands, but they seem unable to free themselves from the tyranny of the leaders whom they have set up. Meanwhile, a productive capacity of 20,000 to 30,000 tons of steel per week is idle for the sixth week. It is quite possible that when the men do decide to go back they will find there is not sufficient work to find them all employment. It is significant that the closing of these works has made very little difference to the other works which were not affected by the strike. Either there have not been many orders transferred or there has been a general falling off in the orders received.

Mischievous Pessimism

The condition of the iron and steel trade has been receiving an unusual amount of notice in the daily Press recently. The *Daily Mail* has published an article in which an attempt is made to prove that the steel industry on the North East Coast—one of the most important centres—is in a dying condition. The writer of the article need not have confined himself to the Teesside for the evidence on which he has based his erroneous conclusion. He would have found a similar state of affairs in all the steel-making centres. In Scotland there is more plant idle than at work. In Lincolnshire many of the large works are closed down entirely, and others are following suit. In South Yorkshire, even if there were no strike, the works would not be more than half employed. The South Wales works are fairly busy, but there also many departments are not working.

Yet, notwithstanding all this, it is not only unnecessary but mischievous to declare that the iron and steel industry is dying, either as a whole or merely in one district. There is no denying the depression that exists in the steel trade, apart from the quietness which is usually experienced at this season of the year, but it still appears to be necessary to call attention to the fact that the productive capacity of the country has been largely increased as compared with pre-War years, so that what might be considered a good volume of trade in 1913 is only sufficient to keep about half the present plant at work.

It has to be admitted that there are some individual concerns which are getting perilously near their end. It is unwise to prophesy in this matter, but we venture to say that when the steel trade does get into its stride again it will be found that some have fallen out by the way, and then will be revealed the wisdom or folly of the many schemes of expansion and reconstruction which were entered upon towards the end of the

war and shortly afterwards. There is a vast amount of money locked up in surplus plant, which may never be operated, money which would be new life to many firms if they could only have it instead of the idle plant into which it has been converted.

No, the iron and steel industry is not decaying. There are still a number of works, up-to-date and skilfully controlled, which will carry on the traditions of the trade for many years to come, in spite of all obstacles. It is significant that one large firm in the North is now in the process of rebuilding the whole of its plant, and it will be eighteen months to two years before the works are in operation. That does not look like pessimism.

Naturally the article in question has called forth a ready reply. It is pointed out that we are actually producing more steel by over a million tons than we did in 1913, and that this year's output is greater than last year's. Moreover, we still hold the lead as exporters of iron and steel.

August Output Figures

The August output figures, as might be expected, were not so good as July. This is due to the holidays and to the strike in South Yorkshire. The output of steel was 162,000 tons down, and pig iron 37,000 tons. It is the worst month we have had for two years, although it was better than the monthly average of 1922 and 1923.

Some good orders for locomotives have been placed with builders in England and Scotland quite recently. The Vulcan Foundry, Ltd., are to build 25, Beyer, Peacock and Co., 15, and the North British Locomotive Co., 15, all for the Buenos Aires Great Southern Railway. Orders for six other locomotives have also been received by two of the above firms for India. Messrs. Turton, Platts and Co., of Sheffield, have received an order for 6,500 forged steel buffers.

On the other hand, it is to be regretted that the contract for six oil tankers, amounting to nearly £1,300,000, has been placed in Holland by the Anglo-Saxon Petroleum Co. The British tenders were thousands of pounds higher than those which were accepted, although no profit had been included. It is understood that the steel work required has to be ordered in this country, which is some consolation. Four more tankers are to be ordered later on, and no doubt efforts will be made by the British shipbuilders to secure this contract.

Some Inventions of the Month

By Our Patents Correspondent

Refining Tin Bullion

A process for electrolytically refining tin bullion has been patented by E. C. R. Marks, London (communicated by American Smelting and Refining Company, of New York). A typical analysis of tin obtained from Bolivian ores is: Tin 93·75 per cent., lead 1·0 per cent., copper 2·5 per cent., arsenic, 1 per cent., antimony 0·25 per cent., bismuth 1·5 per cent. Tin deposits from most electrolytes in crystals which may extend towards the anode and short-circuit the cell, while the other metals, except lead, form slimes on the anode which increase the current required; the lead tends to dissolve in the electrolyte. In this invention, the electrolyte contains some stannous salt, 4–8 per cent. of sulphuric acid, and 2–5 per cent. of hydrofluosilicic acid. The sulphuric acid must be sufficient to convert all the lead into sulphate, and prevent solution of the lead in the hydrofluosilicic acid. The latter prevents the formation of basic salts of tin, renders the anode soluble, and prevents polarisation. An addition agent must also be used, such as glue, molasses, cresol, or preferably cresol sulphonic acid, which forms soluble salts with the metals. The cresol sulphonic acid may be made by sulphonating crude cresylic acid with concentrated sulphuric acid, or sulphonated benzol, toluol, phenol, naphthalene, etc., may also be used. The hydrofluosilicic acid may be omitted entirely if the cresol sulphonic acid is increased from 2 per cent. to 10–15 per cent. Glue is preferably added also to harden the cathode deposit. The temperature of the electrolyte is preferably 95° F.–130° F., and it is possible to dissolve 75–85 per cent. of the anode while still maintaining high conductivity. A voltage of 0·2 to 0·25 volts per tank is found to be sufficient, with a current density of 8 amperes per sq. ft. of cathode. A smooth, dense, and adherent deposit of tin is obtained. See Patent No. 220,012, dated February 28, 1923.

Metallurgical Furnaces

In some metallurgical operations which are conducted in a large electric furnace in presence of a reducing gas, it is desirable to cool the furnace quickly after completion of the operation, and a furnace for this purpose has been patented by the British Thomson-Houston Co., Ltd., London (a communication from the General Electric Co., Ltd., of Schenectady, New York). In this furnace, heating is by means of electric resistances, and means are provided for passing a gas such as hydrogen continuously through the furnace. In order to cool the furnace after the operation, the gas is circulated from the furnace through an external conduit containing small pipes which are water-cooled, and then back to the furnace. The time required for the complete operation is thus very much reduced. See Patent No. 220,119, dated June 22, 1923.

Agglomeration of Ores

A process for agglomerating ores of a pulverulent nature has been patented by E. Poppe of Antwerp. The ore is placed in a rotary furnace, a zone of which is heated to 900° C. by blowing in coal dust at the end opposite to that at which the ore is introduced. The furnace rotates slowly and is of such a length that drying, combustion of organic ingredients, and partial melting take place successively. The mineral constituents are partly reduced by carbon monoxide from the coal dust. See Patent No. 220,195, dated October 15, 1923.

Alloys

Application has been made by Deutsch-Luxemburgische Bergwerks-und Hütten-Akt.-Ges., of Dortmund, Germany, for a patent for an alloy for tools. An example of the composition of the alloy is: Nickel 20 per cent., cobalt 25 per cent., chromium 33 per cent., tungsten 9·5 per cent., molybdenum 5 per cent., iron 5 per cent., carbon 2 per cent., and silicon 0·5 per cent. See Patent application No. 219,293, having the International Convention date, July 16, 1923.

Extracting Zinc

According to an invention by C. J. G. Aarts, of La Haye, Holland, zinc oxide or sulphide is treated in a bath of molten iron containing carbon so as to effect simultaneously the necessary heating and reduction. In the case of zinc sulphide, the carbon may be omitted, and the iron bath is regenerated by blowing in air to oxidise the sulphur, and then removing the slag. See Patent application No. 219,667 having the International Convention date, July 28, 1923.

Iron Alloys

Messrs. H. Etchells, A. Popplewell and L. Cameron and Son, Ltd., of Sheffield, have patented an iron alloy which is resistant to acids, alkalies and salts. The alloy consists of nickel 26–50 per cent., chromium 5–30 per cent., and iron 25–69 per cent., and carbon not exceeding 0·25 per cent. Cobalt may be substituted for part or all of the nickel. The alloy may also contain small proportions of manganese, silicon, sulphur, phosphorus, etc., but the total of these should not exceed 2 per cent. See Patent No. 220,710, dated May 22, May 26, and July 5, 1923.

Aluminium Alloys

It has been discovered by Th. Goldschmidt Akt.-Ges., of Essen, Germany, that the presence of certain compounds of metals with metalloids may be added to aluminium alloys to impart to them special mechanical properties. Such compounds are the silicides, carbides, and borides of the alkaline earth and rare earth metals, such as the silicides of magnesium, calcium, barium, or strontium, calcium carbide, barium boride, cerium silicide, and lanthanum boride. These compounds are taken up in small quantities as solid solutions in the aluminium. The solubility of these compounds in the aluminium crystals diminishes with the temperature. If the alloys are transformed by annealing at higher temperatures into such a state that the added compounds are completely dissolved, and if the alloys are then rapidly cooled by quenching, the added compounds are present in the form of a supersaturated solution. When such alloys are allowed to age, the surplus of the dissolved compounds separates in an extremely fine state of division, which produces a remarkable increase in strength. The limit of such additions is about 2 per cent. The annealing operation takes place at about 480°–580° C., and the quenching may be at temperatures between atmospheric and 100° C. In an

example, the addition of 1·3 per cent. of magnesium silicide in this manner increased the strength of the aluminium by about 100 per cent., with an elongation of 20–25 per cent. The strength of these alloys may be further increased by adding other substances capable of forming mixed crystals, such as copper, zinc, beryllium, etc. The hardness and strength can be still further improved by adding substances having a high melting point, such as nickel, cobalt, iron, chromium, manganese, thorium, tantalum, titanium, vanadium, molybdenum, tungsten, or boron, the total amount of these not exceeding 3 per cent. See Patent No. 221,082, dated September 7, 1923.

Current Articles Worth Noting

We give below a brief index to current articles in the technical press dealing with metallurgical subjects.

ALLOYS.—The ternary alloy system aluminium-cadmium-zinc. N. F. Budgen. *Chem. Soc. Trans.*, August, 1924, pp. 1642–1660. An investigation of the thermal equilibrium diagram for these alloys.

Thermo-electric investigation of nickel alloys. W. Rohn. *Z. Metallkunde*, August, 1924, pp. 297–300 (in German). Relates more particularly to the systems nickel-chromium, nickel-molybdenum, nickel-tungsten and nickel-copper.

WORKING OF METALS.—Metal spraying and sprayed metal. T. H. Turner and W. E. Ballard. *Metal Ind.* (*Lond.*); Part I., September 12, 1924, pp. 245–248 and p. 254; Part II., September 19, 1924, pp. 277–279. An examination of the actual capabilities of metal spraying.

Fluxes and slags in welding. W. Spraragen. *Metal Ind.* (*Lond.*), August 29, 1924, pp. 197–200 and p. 204.

Fluxes for soft soldering. T. B. Crow. *Metal Ind.* (*Lond.*), September 5, 1924, pp. 224–226.

IRON AND STEEL.—Quenching diagrams for carbon steels in relation to some quenching media for heat treatment. H. J. French and O. Z. Klopsch. *Trans. Amer. Soc. Steel Treating*, September, 1924, pp. 251–294. A determination of the "quenching power" of water, oils, sulphuric acid solutions, brines and caustic soda solutions and a study of their characteristics in relation to use for hardening steels.

The macroscopic examination of steel. V. O. Homerberg. *Trans. Amer. Soc. Steel Treating*, September, 1924, pp. 295–314. An explanation of the manner in which segregation takes place in steel.

Stainless steel and stainless iron. O. K. Parmiter. *Trans. Amer. Soc. Steel Treating*, September, 1924, pp. 315–340. A review of the history, manufacture, treatment and properties of stainless iron and steel of the 13 per cent. chromium type.

Study of the reversible reactions of hydrogen and carbon monoxide on iron oxides. G. Chaudron. *Rev. Métallurgie*, August, 1924, pp. 462–472 (in French).

The graphitic softening of cast iron. J. W. Shipley and I. R. McHaffie. *Metal Ind.* (*Lond.*), August 29, 1924, pp. 205–206.

GENERAL.—Application of X-ray crystal analysis to metallurgy. W. P. Davey. *Trans. Amer. Soc. Steel Treating*, September, 1924, pp. 375–392. Outlines the methods used and gives some of the outstanding results so far obtained.

URANIUM.—The preparation of pure uranium. W. Jander. *Z. amorg. u. allg. Chem.*, September 1, 1924, pp. 321–329 (in German). Obtained by the reduction of uranium dioxide with calcium.

LEAD.—Investigation of the removal of antimony from crude lead in the dry way. H. Lerous. *Metall. u. Erz*, September (2), 1924, pp. 421–432 (in German). A study of the reducing action of antimony on lead oxide, of the system lead oxide—antimony oxygen compounds, and of the action of lead pyroantimonate on lead and antimony.

MAGNESIUM.—Magnesium. *Chem. Met. Eng.*, September 8, 1924, pp. 383–386. New method of production described, as also the chemical and mechanical properties of this metal and its alloys.

ELECTRO-PLATING.—Studies on electro-plating. Part III. Addition agents. W. E. Hughes. *Metal Ind.* (*Lond.*), September 19, 1924, pp. 269–273. The effects of acid and gelatin on the structure of electro-deposited zinc.

ANALYSIS.—Applied methods of estimating copper in ores, slags, alloys, etc. *Metal Ind.* (*Lond.*), August 29, 1924, pp. 193–195. Comprehensive treatise of methods of copper estimation.

The determination of sodium in aluminium. D. M. Fairlie and G. B. Brook. *Metal Ind.* (*Lond.*), September 19, 1924, pp. 281–282.

Silicon in aluminium-silicon alloys. J. D. Gat. J. *Ind. Eng. Chem.*, September, 1924, pp. 959–960.

Aluminium in alloys. D. H. Brophy. *J. Ind. Eng. Chem.*, September, 1924, p. 963.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[***NOTE.—The Companies Consolidation Act, of 1908, provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.***]

BODILL PARKER (1922), LTD., Birmingham, ironfounders, etc. Registered September 16, £5,000 debentures; general charge. *£4,000. May 26, 1924.

BOLCKOW, VAUGHAN AND CO., LTD., Middlesbrough, ironmasters. Registered September 9, £744,360 mortgage, to Bank; charged on balance of 8s. per share remaining uncalled upon 1,860,900 ordinary shares of company. *£2,000,000. January 6, 1924.

BLUNT AND WRAY, LTD., London, N.W., metal manufacturers. Registered August 22, mortgage to Bank; charged on lease of 70, Salusbury Road, Kilburn, with machinery, etc. *£8,000. February 22, 1924.

DREW-BEAR PERKS AND CO., LTD., London, S.W., ironfounders. Registered August 21, £10,000 charge, to Dorman, Long and Co., Ltd., Middlesbrough; general charge. *£15,000. December 31, 1923.

SANDERS AND FORSTER, LTD., London, S.E., ironfounders. Registered September 12, mortgage to Bank; charged on Thames Works, Barking. *——. May 21, 1924.

SHIPMAN (J.) AND CO., LTD., Sheffield, steel manufacturers. Registered August 21, charge to Bank; charged on Attercliffe Steel Works and Wire Mills, Attercliffe Road, and Staniforth Road, Sheffield. *£14,528. August 9, 1923.

WELCO PATENTS, LTD., Birmingham, steel manufacturers. Registered September 6, £150, second debentures to H. Jessop, 190, Aston Lane, Perry Barr, Birmingham, medical practitioner; general charge. *£210. September 7, 1924.

Satisfaction

BODILL PARKER (1922), LTD., Birmingham, ironfounders. Satisfaction registered September 16. £4,000, registered February 21, 1922.

The Institute of Metals

THE Institute of Metals programme for the session 1924–25, which commences on October 1, has just been issued. It covers not only the work of the parent institute, but of its six branches located in the various metallurgical centres. Over thirty important lectures dealing with various phases of non-ferrous metallurgy are enumerated in the programme, including the annual May Lecture, by the distinguished Dutch scientist, Professor H. A. Lorentz. Copies of the programme can be obtained from Mr. G. Shaw Scott, M.Sc., 36–38, Victoria Street, Westminster.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, 8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

"Standards"

THE meanings now conveyed in metallurgy by the use of the term standard are at least threefold. First, there is the older and more familiar sense in which the word is used. This is embodied in the name of that invaluable institution, the British Engineering Standards Association. The standards fixed by this association and by similar bodies in other countries are, in the main, of engineering value and interest and relate to sizes and shapes. They are metallurgical as well when they impose definite tests as to strength, hardness, etc.; when they prescribe definite limits of chemical composition; and when, further, they lay down certain processes, either of manufacture or of treatment for the materials with which they are concerned. A second meaning of the word standard is that in which the term is applied in the chemical standards now being issued by Messrs. Ridsdale, and by the Iron and Steel Institute in collaboration with the National Physical Laboratory, in this country, by the Bureau of Standards in Washington, and more recently by the newly formed Society of Typical Samples in Paris. These standards are intended for the use of chemists and to check analytical results. They have been so recently described in these columns as to need no further reference beyond drawing attention to the fact that the French association has carefully avoided using the word standard and calls them what they really are—typical samples. French metallurgists have thus foreseen and provided for the introduction of yet another standard, having a different yet not less useful application than the others. This is a standard test piece, not in the sense of a test piece conforming to a standard form, but a standard possessing definite and ascertained physical properties which will serve to check methods of testing in the same way that the chemical standards serve to check analytical methods. The difficulties of producing even a chemically "standardised" steel or iron sample have been found in practice to be many, but they pale before those which it may be anticipated will be encountered by our French friends and colleagues when they attempt to establish and issue their "typical samples" standardised as to tensile strength, hardness, or magnetic permeability. Of the value of such standards there can be no doubt, but whether they can actually be produced and successfully applied is another matter. In any case British metallurgists will regard with sympathy and interest the work of the French Society, and wish it all the luck possible in a dreary and up-hill task.

The Third Decimal

THE pioneer of the movement for issuing standardised steel samples containing guaranteed percentages of specified elements, in this country, at any rate, is Mr. C. H. Ridsdale, to whom credit is due for having initiated a movement of the utmost value to metallurgical chemists. His long experience entitles him, therefore, to respectful hearing. At a recent meeting of the Cleveland Institution of Engineers, Mr. Ridsdale read a paper dealing in effect with the tolerances allowable in chemical analyses. It is well known that different methods, different reagents and different chemists lead to cumulative divergencies in the results obtained. The question is, within what limits is a tolerance to be established? In his paper, Mr. Ridsdale says "obviously, since the average range of variations, say, on sulphur, under the exceptionally favourable conditions described was 0·008 per cent., the Referee chemist might find 0·038 per cent. and the material be condemned, whilst a chemist of equal status, using the same care, might find 0·030 per cent., which would be passed." The moral he draws is a commonsense one. It is practically to abandon reporting the third place decimal. Any result ascertained by the analyst, who should calculate his results to the third place, should be "returned" only to two places, and the accepted tolerance should presumably be plus or minus the second figure decimal. Thus a result, found by the chemist to be from, say, 0·026 to 0·029 would be returned as 0·030, and conversely, results between 0·024 and 0·021 would be returned as 0·020. Thereafter, and not before, the "tolerances" acceptable to the purchaser (and determined by some responsible body) would operate. It is not seriously held to-day that, from an analytical point of view, the third decimal place has any serious value or interest, nor can it be proved that, in practice, materials are affected by the presence of thousandths of a per cent., except in very special circumstances where they are required as material, or reagents for research. By all means let us dispense with the "third decimal." The wonder is that, in the subsequent discussion on Mr. Ridsdale's paper, so many chemists clung tenaciously to it!

Corrosion-Resisting Steels

THE note in our issue of October 4 on the corrosion-resisting steels produced by the Krupp Company is succeeded in the present issue by a reference to the developments which are taking place in this country. This shows not only that British users are no longer compelled to go abroad for these special products, but that the steels of this type produced in Great Britain are equal to and in some respects even better than the German productions. The two new steels referred to in our "Metallurgical Topics" are the "Era" and "Hecla" brands now being produced by Hadfields, Ltd., a firm which has long been distinguished for its research into these subjects and for its utilisation of the results of research in actual production.

Fluxes and Slags

THE papers presented in April at the general discussion held by the Faraday Society and the Institute of Metals on "Fluxes and Slags in Metal Melting and Working" have just been reprinted, with the discussions arising at the meeting (Faraday Society: London. Price 7s. 6d.). The papers dealt with the fluxes and slags used in connection with the production of non-ferrous metals, brass, lead and copper, and in processes such as welding or soldering. A number of these papers have already been referred to in THE CHEMICAL AGE, notably that on oxy-acetylene welding by Mr. C. Coulson-Smith and that on desulphurising of metals by Mr. B. Bogitch, the last-named paper being given practically in its complete form in the issue of May 3, 1924. The collection of the various papers in one volume should be distinctly valuable for those interested in metallurgical processes.

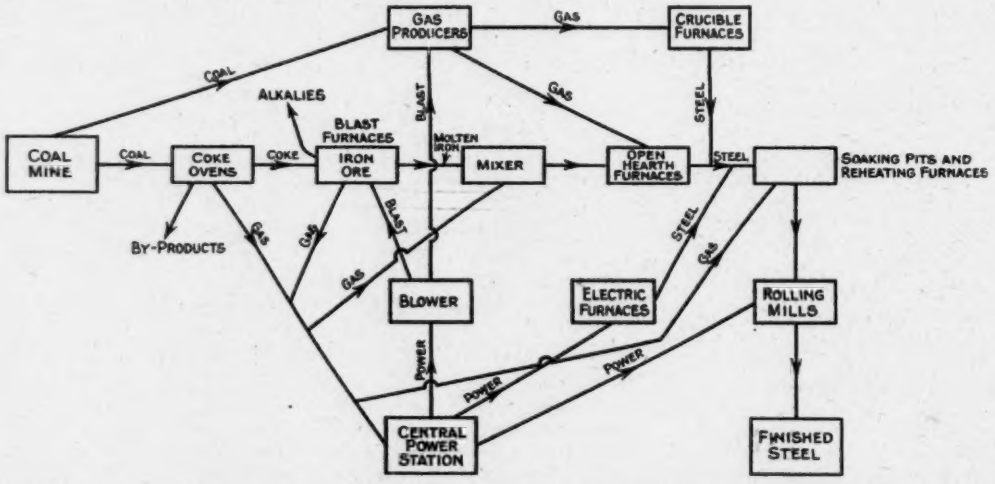
The Arrangement of an Ideal Steelworks

During the past four years the ideal to be followed in steelworks has been that of the utmost economy. The time will come when a large outlay can be expended on reorganisation with the certainty that it will result in more profitable working, and our contributor indicates in the following article how this may be achieved.

THE outstanding disadvantage of most steelworks is the fact that they are not self-contained, and this dependence on outside factors is where we depart most from the ideal. An ideal and complete steelworks should be capable of supplying every want met with in the working of its parts, so that nothing shall be affected by outside influences. Again, the whole concern should be compact, so that both transport within the works and supervision of the works shall be rendered easy.

First, comes the question of environment; for obvious reasons the nearer the works is situated to an ironstone bed of reliable and ample supply, the more efficient will be that steelworks. Furthermore, the steelworks must have its own coal supply; it is essential that the coal mine should form part of the steelmaking concern. It is surely needless to remark that both iron ore and coal should be of high quality; if such supplies of coal and iron ore can be arranged, then the ideal steelworks may easily be developed.

The accompanying diagram shows the lay-out of such a plant. It is manifest that the works, although embracing all the important operations of steelmaking, could be erected in a comparatively small area, and would be absolutely compact and self-supporting. Commencing with raw materials, coal and iron ore, the coal as obtained from the mine, is taken direct to the coke ovens. A battery of coke ovens of the most



modern by-product-recovery type should be erected, as this plant forms an exceedingly important part of our steelworks. The products obtained from the distillation of coal in such coke ovens are:—1. Coke. 2. Condensable by-products. 3. Incondensable gas. The coke obtained is passed on direct to the blast furnace. The by-product-recovery process provides for the condensation of tar and benzol and the manufacture of ammonium sulphate. The incondensable gas is conducted to a large central power-station.

Arriving at the blast-furnace, coke is supplied from the coke ovens, iron ore is ready to hand, whilst the flux, limestone, is invariably easy of access. Moreover, as will be shown later, the energy of the coal gas, together with the blast-furnace gas, is converted into power at the power-station. One of the many functions of this large power-house is to operate a blower which supplies the blast to the blast-furnace.

The products of the blast-furnace are, of course, molten pig-iron, slag, and waste gases. The molten iron is passed direct to the mixer and thence to the open-hearth furnaces; disposal of blast-furnace slag is not difficult; alkalis should be recovered from the dust-laden gases and the waste gas conducted away with the coal-gas to the power-house. The mixer is heated by means of tapping this supply of gas.

The open-hearth furnaces constitute one of the main portions of any steelworks, and a short discussion of their merits, etc., will not be out of place. Since, in such a steelworks as this, the open-hearth furnaces would invariably be worked on molten pig-iron of regular composition, the Talbot Continuous Furnace has much to recommend it. Such a furnace, of 200 tons capacity and upwards, is as easily worked and managed for this class of work as a small furnace and the continuous action is a great asset. Assuming, therefore, that furnaces of this type were to be set up, a large and continuous supply of producer gas would be required. A battery of a dozen modern producers would probably meet the case, as there are several types which are very efficient. The blast for these producers would be supplied by the blower already mentioned.

The open-hearth furnaces would, of course, heat their own regenerators with the waste gases produced. From the open-hearth plant, the ingots would go to the soaking-pits; these soaking-pits would be heated by means of tapping the coal-gas and blast-furnace gas supply, as in the case of the mixer. This mixed gas supply, so often mentioned, would provide a really workable product, its approximate constitution being CO_2 10 per cent., CO 18 per cent., CH_4 20 per cent., H_2 30 per cent., N_2 22 per cent. This would give a calorific value of about 350 B.T.U. Thus all ingots could be kept heated until required for the rolling mills.

The rolling mills form another self-contained unit, as the power required is supplied from the central power-station. Again, the need for numerous reheating furnaces is done away with by having a number of soaking pits, and such reheating furnaces as are essential can be heated from the same gas supply. It should be remembered that this supply of coal-gas and blast-furnace gas would be enormous. The rolling mills would also have to deal with the products of the crucible and electric furnaces, "stainless" and other special alloy steels being made by these means. The crucible furnaces would be gas-fired, the producer gas as supplied to the open-hearth furnaces being used. The electric furnaces would get their transformed current *via* the power-station. From the rolling mills, therefore, we should be getting finished steel of all qualities and varieties; this would be achieved without dependence on any outside influences.

It will readily be granted that from a purely theoretical standpoint such a system of working is ideal; the majority of people interested in the steel trade would, however, insist that the idea is impracticable. This is not the case, for careful consideration of the plant as a whole, and subsequently of each working part, fails to reveal any insurmountable difficulty. Admittedly there are difficulties; but surely it is worth while to set up and perfect a plant which, when in full working order, is obviously far superior to the ordinary type of steelworks

Not only is this superiority shown in the smooth working of the different component parts of the concern and in the regular output of uniform quality products, but from the economic standpoint the plant would be on a very sound footing. Fuel economy is one of the outstanding features of the day, and rightly so for our present methods of fuel control need much reform. Such a plant as is outlined here strikes at the root of the fuel trouble, *i.e.*, the lack of central control. A fair estimate of the total fuel consumption of the steelworks would be 2½ tons of coal per ton of finished steel. Moreover, the output is absolutely complete; all types of steel and iron can be produced with equal facility; also, the by-products may include coal, coke, tar, benzol, ammonium sulphate and alkalis.

From such a self-supporting plant as this, even in periods of slack trade, like the present time, a profitable output of all these kinds of material is possible, providing that there is a demand at all, and even nowadays there is a demand for reliable products. The most convincing argument in favour of the development of large self-contained steelworks is, however, before our eyes. Those concerns which, if falling short of the absolute ideal, do at least tend that way, are found at the present moment to be the most prosperous, and their future is still more promising.

Copper Smelting with Calcium Carbide

A Chloride Reducing Process

Of recent years calcium carbide has been put to more uses than the simple production of acetylene gas. It has been successfully employed as a reducing agent for metallic oxides, ores, and salts. One of these processes which has received not a little attention lately is the reduction of chlorides, which are particularly adapted for this treatment. Copper, lead, nickel, and silver can all be reduced by applying the same principle, the reaction taking place in the case of copper corresponding to the equation :—

$$4CuO+CuCl_2+CaC_2=5Cu+CaCl_2+2CO_2$$

That is, on smelting a mixture of oxide and chloride of copper with calcium carbide, copper and calcium chloride are produced with evolution of carbon dioxide.

The interest which was aroused by this reaction lay in the fact that copper is converted to a mixture of oxide and chloride when the metal is recovered by the wet extraction method.

The Wet Copper Process

In the wet process for copper extraction the finely ground ore is roasted with salt in specially designed reverberatory furnaces. After roasting, the mixture is discharged into large wooden tanks and the soluble copper salts washed out with acidulated water. The acid is prepared from the furnace gases which are led into condensers and absorbed in water. When the salts have dissolved, the liquor is run into vats and treated with scrap iron, which precipitates the copper as a brown sludge. This sludge is passed through a series of furnaces and eventually obtained as the pure metal.

It will be observed that a process such as the foregoing requires the use of extensive plant, besides the services of a considerable amount of labour. The process, therefore, is only applicable where large consignments of ore are forthcoming. By employing calcium carbide, a great many of the difficulties encountered with the older process may be obviated, and also small quantities of ores may be worked economically.

The Carbide Process

Many scientists labour under the impression that the roasting of copper ores with salt produces chloride of copper alone. This erroneous statement has also appeared in many of the smaller text-books on chemistry and metallurgy.

The roasting is actually so conducted that the copper is partially oxidised and partially chloridised, with a view to producing that compound of the metal which is most readily soluble in acidulated water. It is evident, therefore, that this same mixture would be eminently suitable for smelting directly with calcium carbide.

Owing to the high market price of the carbide, this more modern process has not had the same chances of development, and the work has been largely confined to the experimental stage up to the present time.

The roasted ore and salt are transferred to a stone floor and a proportion of carbide added. As the chlorides are liable to become moist on exposure to the air, the mixing of the mass must be conducted without loss of time. This is usually done by rapidly shovelling the material into small heaps and then accumulating them together, when the whole is charged on to the sloping bed of a reverberatory furnace. Any moisture present would completely nullify the effects of the carbide, and the chlorides must be absolutely free from water to prevent decomposition of the former in the cold. The proportions of oxide and chloride of copper in the mass are controlled by accurate manipulation of the charge while roasting. The amount of air entering is so measured that oxidation is proceeding besides chloridisation, with the result that the roasted mass approximately contains four parts of oxide to one of chloride. If this extent of oxidation cannot be reached satisfactorily, an admixture of pure oxide ore of copper can be made.

In the smelting process a further addition of salt is necessary to produce easy fusibility of the material. A more serviceable flux consists of a mixture of salt and potassium chloride, but on account of the extra expense it has not received the same application.

Rapid Smelting Desirable

The smelting is comparatively simple but requires to be performed rapidly, as slow heating would decompose the carbide unnecessarily. It is a usual practice to raise the temperature of the furnace bed to a bright red heat before charging the mass. The gases escaping are, of course, highly inflammable at first, but on the open bed of the furnace not dangerous. The flux allows the mass to melt and flow to the well of the furnace in a short time. At this stage the carbide is decomposed and the acetylene gas set free passes through the molten mass and reduces the copper to the metallic state.

The reduction similarly affects any nickel, lead, or silver present in the ore.

Dealing with the By-Products

The slag is scraped off the surface of the metal and allowed to cool slowly, after which the copper is refined by usual methods. As the slag always contains a certain amount of undecomposed carbide, and is of a comparatively fusible nature, it is broken up when cold and stored in air-tight barrels for future use.

Generally speaking, the bulk of the acetylene gas evolved is decomposed with formation of carbon dioxide. The extent of this decomposition can be approximately judged by examining the colour of the flame which passes from the well of the furnace after the mass has become molten.

Tests of the composition of the slag are made periodically during the smelting process, by taking samples and having them analysed. The principal test is to estimate the percentage of acetylene remaining, by decomposing the powdered sample and determining the yield of gas in a "Caro's" or "Gatehouse's" apparatus. These tests are of the greatest importance, since no carbide can be added once the charge is molten. An excess of carbide is always employed at the commencement, but this requires to be varied with different copper ores. This method of working is not a very economical one, since when dealing with a new ore a considerable excess must be employed with the first charge. Research work is at present being conducted with a view to finding a means of introducing carbide to the mass in the furnace, while molten. The great difficulty encountered is that the added carbide floats on the surface and becomes decomposed without exerting any reducing influence, whereas when mixed with the ground material its action is very effective.

It may be mentioned, in conclusion, that the same process can be successfully conducted in crucibles, but it is attended with a little danger, as the gas evolved is not given the same opportunity for escaping.

C. C. D.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

British Corrosion Resisting Steels

FOLLOWING the recent announcement in our columns of corrosion resisting steels of high strength of a new type produced by a German firm, our readers will be interested to learn that British steel makers are in no way behind the times, but on the contrary in many respects lead the way in this new and useful field. The new types of corrosion and heat-resisting steels which have been developed in this country should do much to solve some of the problems which have hitherto retarded progress by the engineer, and particularly the chemical engineer.

The requirements in this direction led Hadfields, Ltd., of Sheffield, the well-known steel manufacturers, to devote, in collaboration with the Société Anonyme de Commentry Fourchambault & Decazeville, of Imphy, France, considerable research to the production of suitable steels with highly successful results. These are embodied in two new steels known under the trade names of "Era" and "Hecla," each with outstanding qualities in its own field. These steels have attracted much attention on Hadfield's stand in the Palace of Engineering at the British Empire Exhibition.

"Era" Steel

"ERA" steel is non-scaling and resistant to corrosive gases and vapours at temperatures up to 1,000° C., and combines with this important quality great strength and toughness at high temperatures. At a temperature of 900° C. it possesses a tenacity of 15 tons per sq. in. with a ductility of 35 per cent., and with correspondingly higher tenacities at lower temperatures. This important new product will be welcomed by many engineers, particularly as it can be supplied in the form of castings, in rolled bars or sheets, or shaped forgings, and, further, is readily machineable. In particular it is more resistant to the effects of sulphurous products of combustion than alloys of the type containing high percentage of nickel which have been tried and proved unsuccessful where these conditions exist.

Among the many applications for which this steel is highly suitable are various parts of furnaces subjected to high temperatures, such as tubes for furnace muffles, agitator arms for gas producers, scrapers and agitators for ore roasting furnaces, carbonising boxes, pyrometer tubes, also for such purposes as motor-car and aeroplane valves, and blowing nozzles and pontle bars used in the glass industry, although such a list does not represent by any means the extensive field of use. Another useful property of "Era" steel is that it is non-magnetic.

"Hecla" Steel

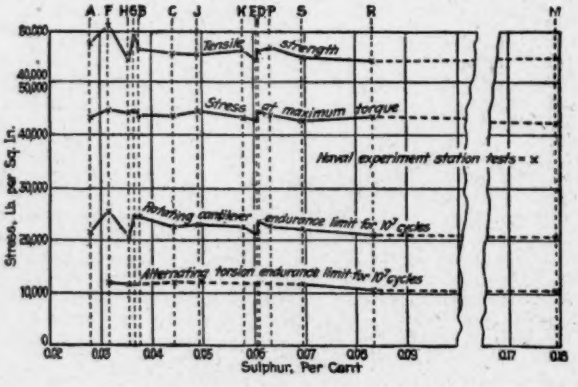
"HECLA" steel is a type developed especially to fill the want of a suitable material for resisting the action, both erosive and corrosive, of moderately high pressure steam in steam turbines and other steam plant. There are many cases in connection with steam turbines where the blades, nozzles or valves when made in the usual nickel steel rapidly deteriorate, resulting in loss of efficiency and frequent replacement, with consequent expense and disturbance to regular working. These troubles particularly arise where the steam is highly superheated or under conditions of condensation at the low pressure end; also where contaminated water is used for steam raising, which occurs especially with marine turbines, or land turbines situated near the coast. "Hecla" steel has proved in actual service unaffected by such conditions, against which steels containing a high percentage of nickel or of chromium have not proved effective. "Hecla" steel has the further advantage of being readily machineable, and its qualities are not dependent upon special heat treatment, nor upon the provision of a highly prepared surface, also lending itself in every way admirably to the processes involved in turbine building.

It is of interest to note that the qualities of these two new steels give them excellent recommendations for use as non-corrodible steels for a variety of purposes, that is at ordinary temperatures, being resistant to atmospheric or sea water corrosion, and a large number of other corrosive agencies.

Hadfields, Ltd., are also manufacturers of other types of non-rusting or non-corrodible steels, including their "Galahad" brands in hard and soft grades, of the type familiar for its use in the form of cutlery, although it is suited to many other domestic and engineering purposes.

Sulphur in Steel

SOME endurance tests in connection with the effect of sulphur on steel have lately been studied at the Naval Engineering Experiment Station at Annapolis. The chart shows the results of these tests as applied to rivet bars after annealing. From these curves it is seen that sulphur has no effect on endurance, while previous tests conducted at the same station indicated that sulphur had no effect on tensile strength or any other of the usual strength and ductility properties. The variations in the curves, especially as regards the low-sulphur steels, have been shown to be due to the variations in the manganese and carbon content. Investigations of the microstructure at magnifications from 100 to 4,000 of the rivet steels revealed differences in the number of non-metallic inclusions, with a distinct tendency toward a larger number of inclusions in the steels of higher sulphur content. Strength tests of plate steel of structural grades also revealed no indication of sulphur influence.


A F H S B C J K E D P S R M
Tensile strength
Stress at maximum torque
Naval experiment station tests = x
Reversing cantilever endurance limit for 10⁷ cycles
Alternating torsion endurance limit for 10⁷ cycles
Stress, Lb. per Sq. In.
Sulphur, Per Cent

Colloids and Corrosion

AT a conference of electrochemists held at Detroit early in October a number of British and American chemists described experimental work which has recently been carried out on corrosion. Dr. J. Newton Friend and his co-workers, Messrs. D. W. Hammond and G. W. Trobridge, in a paper on "The Influence of Emulsoids Upon the Rate of Solution of Iron," showed that emulsoids or protective colloids exert a very pronounced retarding influence upon the rate of corrosion of iron. This retardation is due to the adsorption of the emulsoid. A possible method is suggested of treating natural and other waters, to render them less corrosive toward ferrous and non-ferrous metals in practice. In the experiments recorded, small plates of steel were suspended in solutions of lead acetate, to which small measured quantities of agar were added. The results show a marked retarding action of the agar with rise in concentration. In dilute sulphuric acid and stationary plates the retarding effect is readily detected. However, if the plates (as discs) are rapidly rotated, little protective effect is observed. The fact that iron cooking utensils resist corrosion remarkably well may be attributed in part to the protective action of the colloidal food material that is cooked in these utensils.

Presence of Air Unimportant

A CAREFUL study of the surface was made by Professor C. H. Desch, of the University of Sheffield, and described in his paper entitled "The Microchemistry of Corrosion." The initial stages in the process of corrosion are of great importance as the nature of the product largely determines the subsequent course of the process.

It is also interesting to note that Mr. James A. Parsons, of the Duriron Co., Dayton, found that in the corrosion of riser

pipes the presence or absence of air was not as important as is usually believed. Water is essential, but the rate of corrosion is more dependent upon the metallic composition and metallographic character of the pipes than upon the quantity of oxygen present.

What is Steel?

To define certain general terms in specific terms is as impossible of satisfactory accomplishment as to average incomparable quantities. The "steel" of yesterday is not the steel of to-day, nor will it correspond with that of to-morrow. To assume that it is capable of finite and final definition is to assume that the material is always identical, that processes remain the same and that progress or improvement is impossible. For all practical industrial purposes, and with recondite scientific ones it is not necessary in this connection to deal, iron is placed on the market in three forms—cast iron, wrought iron and steel. Cast iron is very impure, wrought iron is very pure, and steel is, except for the presence of a certain amount of carbon, almost as pure as wrought iron and so perfectly distinct from cast iron that no possible confusion can exist between the two. The difference between wrought iron and steel is mainly a question of the amount of carbon present. When this falls appreciably below 0·080 per cent. the material is iron; when it is above this amount it is steel. Armco iron is not steel; its makers do not claim that it is. Nor is electrolytic iron, steel. It is iron. The precise point of carbon content is not vital. A bad wrought iron may have a little more; a badly made "wild" steel a little less. When, from this point of view, any possible doubt arises, the question of the process by which it has been made and the presence or absence of appreciable slag will decide the issue. There is no royal road and no all-embracing definition possible. Professor Sauveur's attempt is no better and not much worse than previous attempts have been. He defines steel as "an alloy of iron and carbon usually containing substantial quantities of manganese." Obviously this will not do. It would comprise white pig irons and even spiegel. It is, however, easy to make destructive criticisms. What it is not easy to do is to be constructive. There are some questions to which no simple answer is possible. There are some things which appear to be indefinable.

Stainless Steel for Cutting Tools

An interesting résumé of the properties of stainless steel was given by Mr. O. K. Parmiter, of the Firth-Stirling Steel Co. at a meeting of the American Society for Steel Treating held at Boston at the end of September. He pointed out that no claim is made for stainless steel as a suitable steel for cutting metals. Its cutting field is limited to table cutlery, pocket knives, surgical instruments, meat-cutting blades, leather knives, etc. For these purposes it serves admirably. There has been just a little contention in the past as to the extent to which stainless steel is capable of retaining a keen cutting edge. The fact must be taken into consideration that the best knife is the one in which hardness and resiliency are about equally proportioned. This condition can be obtained in stainless steel. The cutting qualities of stainless steel when properly hardened compare very favourably with those of the best grades of carbon steel knives.

Machining Properties of Stainless Steel

Stainless steel can be annealed very soft. In this condition it will show a Brinell value of about 150, but its machining properties will be poor. It is generally agreed that a very soft steel cuts "gummy," pulls and drags, making it undesirable for any purpose requiring a smooth, clean surface. The same is true of stainless steel. Good machinng properties in this steel cover a range of hardness of from 200 to 300 Brinell. Even at the high point of this range the material cuts well, although a little crisply. For any purpose where sharp angles or machined surfaces free from roughness and unusual distortions are desired, the harder material is recommended. Still another feature of the harder condition of the steel, which is the result of hardening with subsequent tempering, is that in addition to its machining properties it still retains most of the stain-resisting qualities which it possessed in the hardened condition.

Stainless steel conducts heat very slowly, and its expansion upon heating is less than that of carbon steel. These two characteristic properties in conjunction make drilling difficult. Frictional heat is generated, which is slowly dissipated, causing the drill to unduly heat up and gall, unless precaution in the way of a cooling and lubricating medium is used.

Steel Corrosion by Ultra Violet Rays

In determining the effect of ultra violet rays upon various steels at the U.S. Bureau of Mines, the rays were played upon polished surfaces of Armco iron, medium-carbon steel, "stainless" steel, and high nickel steel. The treatment was continued for 18 hours, when it was noticed that very pronounced changes were effected on the steel surfaces. The specimens were cooled and the moisture of the breath allowed to condense on the surface, throwing the exposed area into relief at once, the drops of condensation being larger on the unexposed section of the metal. Very noticeable corrosion of the medium-carbon steel was noted, while the chromium and nickel steels showed no effect at all.

Distinguishing Wrought Iron Pipe from Steel

Distinguishing wrought iron from steel is not always as easy as some imagine, but there are certain tests which are infallible. In the case of pipe, for instance, the manganese test, if the apparatus is handy, is the most reliable. In this test chips are taken from the respective metals and cleaned thoroughly from rust, galvanising or paint, and placed in a test tube with about 10 drops of nitric acid, diluted with an equal quantity of water. The tube is then heated over an alcohol lamp for a few seconds and then cooled. A small amount of sodium bismuthate is added to the tube and the colour noted. A decided pinkish tinge indicates steel at once, whereas if the sample is wrought iron the solution will be light brown, gradually fading and leaving a brown residue at the bottom of the tube. This test is based on the fact that manufacturers add to the fluid metal in the Bessemer retort or converter a certain amount of ferro-manganese in order to make it possible to roll and weld the over-oxidised metal. In the manufacture of genuine wrought iron only an insignificant amount of manganese is used.

The mechanic's test is of a different nature, and may be conducted with a hammer. If a piece of galvanised pipe is hammered repeatedly so as to flatten it, the zinc coating adhering firmly to the pipe showing little effect of the hammering or flattening indicates wrought iron. If the zinc begins to scale off after a few strokes of the hammer, the pipe is steel. Repeated blows will bring the zinc off in large flakes, leaving the steel bare in spots.

If the pipe section is hammered to fracturing point, the fracture of good wrought iron is ragged, dull grey and fibrous, and the fibre is very distinct as compared with that of steel. A steel fracture is even, bright and crystalline, and when exposed to the atmosphere it soon loses its lustre. Steel pipe often shows a tendency to fracture at the weld, and the metal here presents a smooth, dull grey appearance, which is distinguishable from the fibrous fracture of wrought iron.

When wrought iron pipe is threaded its fibrous structure causes the chip to break and crumble as when dressing a piece of wood. In the case of steel, owing to the absence of fibre, the chip curls, sometimes forming a long, more or less perfect spiral.

A New Type of Stainless Steel

Further research by Sheffield metallurgists has produced another type of stainless steel which is so malleable that it readily submits to being cold-pressed, thus opening up a very wide field for its uses, says *The Manchester Guardian Commercial*. The new type will tend to supplant the "stainless iron." In the original type the percentage of carbon produced the difference in the qualities, "stainless iron" having a carbon content about one-third that usually associated with stainless steel. While this characteristic is retained in the newest type, the metallurgist has discovered that malleability is secured by alloying a considerable percentage of nickel with a rich content of chromium, which also provides the stainless or rustless quality. "Rustless" is the description which the makers use. It is claimed that the new material is unaffected by the acids which usually find the weak spots—tartaric, citric, formic and lactic acids, as well as phosphoric acid in all its strengths. It can be turned, milled, planed and welded by the electrical processes, while soldering, brazing and tinning processes are readily accomplished.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

ANY hope that there might have been of a brightening in trade in October has been dispelled by the General Election which has been forced upon the country. A certain amount of interference with business is inevitable on such occasions, and in the present instance this interference will be more marked, as a particularly keen interest is being taken in the election by business men up and down the country. The general impression is that what is done now will have far-reaching effects on the prosperity of our industries. If the efforts that are being made are rewarded by the putting into power of a stable Government we can look calmly on the October dislocation of trade.

Dismal October

Meanwhile, apart from the election, October has been a dismal month for the steel trade. An official reduction of 10s. per ton has been made in the prices of plates, both boiler and ship quality, and in sections. This has been done presumably with the object of bringing more business. If so, it has entirely failed. There are no more orders being given out, indeed in some districts the reports indicate that the reduction has delayed business. It is difficult to justify the step that has been taken. It is true that there have been reductions in the cost of raw materials, notably in fuel, but these reductions have long been discounted in the price of the finished materials. Prior to the War selling prices were reduced as a natural sequence to lower costs of raw materials, and that could be so simply because selling prices were generally kept ahead of costs. But the position is now reversed. Selling prices are, and have been for a considerable time, below the cost of manufacture—an unhealthy and unnatural condition—and the manufacturer's only hope of regaining his balance is in a lessening of the cost of his raw materials. To translate this relief into a further immediate reduction in price of finished steel is only prolonging a condition which must ultimately lead to liquidation.

Unfortunately the old customs prevail, and consumers insist on a reduction in price as soon as they hear of the lower cost of fuel, etc. The pig iron market has shown this very markedly. The blast furnace owners held out for as long as they could, but the absence of orders made them give way, and now practically the whole of the reduction in cost has been passed on to the consumers. Notwithstanding this, the market is very weak and buying is no freer than before. The practice of buying only for immediate needs still continues. No doubt a favourable outcome of the election will cause a stiffening of the market and bring about some forward buying. The most cheerful reports come from the Cleveland area, where the tone seems to be steady. The output is reduced and stocks are remaining almost stationary, so that any increase in demand would at once strengthen the price. Export trade does not improve, business being very limited.

Less Furnaces in Blast

A comparison of the blast furnace returns for the quarter ended September 30 with those of the previous quarter shows that there are 18 less furnaces in blast. The total number at work is 172, little more than one-third of the total number built.

The bar iron makers have followed the lead of the steel makers and have officially reduced their prices 10s. per ton, but they are not able to report better business as a result. Indeed it is impossible for them to find sufficient orders to keep the mills in regular work. The competition from the Continent is strong, the foreign quotations being from £4 to £4 10s. under the English; and the makers of small steel bars still secure a lot of trade which would go to the iron works if the prices of the two qualities were not so widely apart. The only bright feature is the marked bar trade. There is a good inquiry for these and makers are fairly well off for orders. The reduction of 10s. per ton does not apply to marked bars.

Reports from the steel works are no more encouraging. Specifications are scarce. The reduced prices have effected no improvement in this respect, and already the new level of prices is being abandoned by some of the more needy works. We know of definite quotations of £9 5s. per ton for plates, including delivery at the consumer's works. This price is 10s. per ton below the newly arranged official price. It takes us back to the worst period in 1922 when such heavy losses were made by so many steel works; and those losses are likely to be repeated if such a price continues.

Foreign Plates

There is an appreciable quantity of foreign plates being bought in this country. Many of the constructional and engineering contracts are secured at such cut prices that the use of British steel is out of the question. One such contract, involving the use of about 700 tons of steel plates, has just been secured by an English firm who has offered the order for the plates to several British works on condition that they quote a price comparative with the foreign quotation. Seeing that the present difference between the two markets is from £2 to £3 per ton, there does not seem much likelihood of the order being placed here.

In this connection it is interesting to note that Messrs. Dorman, Long and Co., of Middlesbrough, have secured an order for over 15,000 tons of steel plates, which are required for the construction of oil tank steamers being built in Dutch yards for British owners. We should like to know the price at which the order has been taken!

The official price for sections is now £9 5s. per ton as against £9 15s. last month, but this is not strictly a hered to, as even this price does not tempt much buying. It is quite possible that the effect of the reductions has been to make the buyers hold off in the hope of still lower prices.

The prices of English billets have also fallen, but they still have no chance against the continental billets, where quality and prompt delivery are not essential factors. The home price varies from £7 10s. to £8 per ton, being at least 30s. per ton above the foreign quotation. Acid steel billets have now been reduced 20s. per ton. This is a rather drastic reduction and may put some life into this particular branch of the trade.

The strike at the three large steel works in South Yorkshire is now over and the men are back at work. No doubt they will console themselves with the thought they they have fought for a principle, but the fact remains that all that the strike has done for them is to lose them eight weeks' work at an increased rate of wages. The orders that have accumulated during the stoppage have enabled the firms to make a good start.

International Steel Combine

There has recently been a revival of the suggestion for an international steel combine, which should embrace not only Europe but the United States as well. There is no probability of the United States falling in with such a proposal, as it is very doubtful whether their law would permit them; nor does it seem likely that the European combine will take definite shape. Certainly the competition between the various countries has gone to extreme limits, and has resulted in severe financial loss all round, but the difficulties inherent in such a scheme are, we think, too great to be overcome.

Lord Invernairn, the Chairman of William Beardmore and Co., speaking at a recent meeting, made a similar suggestion, but on less ambitious lines. He was of opinion that the years of depression which the iron and steel industry had experienced had left it in such a dangerous condition that it was necessary for some scheme to be adopted for reorganising the industry so as to eliminate needless expenditure in purchasing, manufacturing and administration, and for this purpose he favoured closer and more effective co-operation between the various companies. Such a system was in force in Germany before the War, where a central selling organisation distributed the orders to the works best fitted to execute them economically. It is probable that the system will be revived in Germany, but its adoption in Britain is not likely at present. Nevertheless, unless the depression lifts there seems to be no alternative but for some of the less efficient plants to close down altogether.

The returns of the imports and exports of iron and steel are worthy of note. For the first nine months of this year the exports amounted to 2,929,162 tons, and were 252,013 tons less than the same period in 1923, although they were over half a million tons more than in 1922. In the pre-war year the exports

were very nearly 5,000,000 tons. The only way to secure a more normal proportion of the foreign trade is to accept orders at prices which involve a loss, and this will remain so so long as the present handicaps exist. Fuel, wages and transport costs are still much too high, and to these has to be added our unexampled burden of taxation. No wonder that the foreign competition is working such havoc!

The position is brought home still more forcibly when we consider the imports of iron and steel. For the first nine months of 1924 they total 1,753,659 tons as against 1,010,833 tons in 1923 and 597,336 tons in 1922. Of this year's imports 1,050,258 tons, or 60 per cent., represent pig iron and semi-finished material, the remainder being finished products. What a difference it would have made to the iron and steel trade here if this work, or a large portion of it, could have remained in this country! That is something to wish for but not to expect with our high production costs.

Detection of Flaws by X-Rays

Testing Plant for Use in Dangerous Processes

In petroleum cracking the temperature used is around 750° F., at which point the strength of steel is not at its best, a point of great importance when the steel is used as a part of a container under an internal pressure of somewhere around 100 lb. per sq. in. Any flaws in the steel parts of this container or any particular thinness will magnify the hazards of the operation. *Chemical and Metallurgical Engineering* states that many of the refining companies have made a particular study of their steel on the cracking units, involving materials, design and surface inspection. The Sinclair Refining Co. has been carrying on intensely such an investigation and inspection since 1919 and it attributes much of its success in the prevention of fires to this.

Cast steel in particular is liable to porosity and cracks from various causes in varying degree, entirely undiscernible by an ordinary physical inspection, and in most cases where they may be discernible they have been welded so that the inspector is not aware of their presence. An earlier article by Dr. H. H. Lester in *Chemical and Metallurgical Engineering* (February 15, 1923) described results obtained by the X-ray examination of castings. Such a method showed promise of virtually looking through the casting, showing up such internal defects as inclusions, porosity and cracks. Some of the Sinclair company castings have since been examined by this method and the defects found were as dangerous as or more dangerous than many of the defects found in the ordinary way. The investigation was broadened and a definite study of casting defects was undertaken. This was done because study up to this point had seemed to indicate that the foundries were doing their best and that no amount of increased rigidity in inspection could insure sound castings. It seemed to the Sinclair company that it would serve itself, other casting-using industries and the foundries too, by making a study of casting defects to the end that the defects might be removed by improved methods of manufacture rather than by increased rigidity of inspection. It is realised that by means of X-rays increased rigidity of inspection could be inflicted on the suffering foundries, but it would seem that a better and a more economical procedure would be to use the X-ray as a constructive tool as an aid to the manufacturer rather than as a destructive tool, as the foundries would view it, by putting it on acceptance inspection alone.

Method of Making Tests

The tests were planned to reveal defects and to correlate them with probable causes. X-rays were relied upon to locate the defects and to give an idea of their nature. A simple arrangement of the casting, the source of X-rays and the photographic film was devised. In practice, the casting is marked off into areas through which radiographs are desired. Defects, such as cavities, cracks or inclusions, are indicated as dark spots on the X-ray negatives. To get more complete information, the castings were cut through some of the defects shown. In cutting, usually a double saw was used, and a $\frac{1}{8}$-in. cross-sectional piece taken out. This was surface ground and the defects revealed were examined carefully. Inclusions shown were picked out and analysed. After this, the section was radiographed and later etched by boiling in a solution of hydrochloric and sulphuric acids. This treatment develops cracks, cavities, spongy areas and differences in metal texture. In many cases cracks too fine to be revealed by X-rays and by surface inspection are developed in this way. The number of X-ray pictures taken varied with the castings, the average number being seventeen. The pictures were of different sizes, 5×7, 8×10 and 14×17 in., depending on the size and contour of the portions to be radiographed. The average area covered in each picture was approximately 64 sq. in. The thickness of the sections radiographed varied from $\frac{1}{2}$ to 3 in. The castings varied in weight from 65 to 1,400 lb. In one casting of average size 63 per cent. of the metal surface was actually covered by the radiographs. Probably the average metal radiographed was between 30 and 50 per cent. of the total metal of the casting. Of course, vital sections were covered more closely than sections of less importance. This is the usual procedure in the X-ray laboratory, the number of pictures taken depending on the information desired.

The conclusion is reached that when steel equipment is to be used in a service where the characteristic defects of steel castings are considered hazardous, the situation may be met by one of three possible courses:

1. Forgings may be substituted for castings.
2. Steel castings may be used and X-ray inspection added to the present accepted methods of inspection.
3. Steel castings may be used that have had the characteristic defects eliminated by manufacture in accordance with a carefully developed casting technique. From the investigation covered in the paper, it would appear that the casting technique can be readily developed with the aid of X-rays.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in The Chemical Age.

Aluminium Alloys

Application has been made by Vereinigte Aluminiumwerke Akt.-Ges. Lautawerk, Lausitz, Germany, for a process for improving aluminium alloys containing copper and silicon, but no magnesium. The alloy is heated to 500° C., press rolled to its final dimensions, heated for three hours to 500° C., cooled, and then hardened at a low temperature. See Application No. 220,602, having the International Convention date, August 16, 1923.

Titanium Steel

A process has been patented by W. Mathesius and H. Mathesius, of Charlottenburg, Germany, for producing hard and malleable titanium steel. It has been found that the previous failures to obtain a satisfactory titanium steel have been due to the presence of carbon in the steel, so that the added titanium formed titanium carbide. If the carbon is eliminated, a malleable steel is obtained which has an elasticity only obtainable in carbon steels after hardening.

To produce this steel, iron is refined in a furnace having a basic lining with the addition of a basic slag, so that the carbon is removed as completely as possible. A slag coating is used which consists of lime, manganese ore, and titanium iron stone. As long as the bath contains carbon, manganese and titanium and some silicon are introduced into it by the reducing action of the carbon. At this stage aluminium is added, and reacts with the slag, so that the large proportion of the titanic acid contained in it is reduced, and titanium passes into the iron bath. This alloy is almost free from carbon and has a very dense structure. A refining process is also described by which the alloy may be entirely freed from titanium carbide. See Patent No. 221,529, dated April 11, 1923.

Reduction of Tin Ores

A process for the reduction of tin ores containing iron has been patented by The Cobb Electro Reduction Corporation of Canada, Ltd., of Toronto, Canada, with the object of preventing the separation of the iron with the tin, which may occur in a pure electrolytic process. This result is obtained by adding silicious material having a greater affinity for iron than for tin in such proportions as to combine with substantially all the iron. The reducing agent is also introduced into the bath so that the reduction of the ore is effected partly by the chemical action of the reducing agent, and partly by electrolysis. The reducing agent may be charcoal, coke, or culm. A detailed description is given of the apparatus employed, which is not in itself novel. See Patent No. 221,848, dated June 11, 1923.

Current Articles Worth Noting

We give below a brief index to current articles in the technical press dealing with metallurgical subjects.

CHROMIUM.—Chromium—its uses and its alloys. Part II: W. M. Mitchell. *Blast Furnace and Steel Plant*, October, 1924, pp. 452–455. Describes its use for the manufacture of alloy steels and heat and corrosion resisting alloys.

ALUMINIUM.—Aluminium and its alloys. Part I. Aluminium foundry practice. *Metal Ind.* (*Lond.*), October 10, 1924. pp. 351–353.

GENERAL.—The application of the law of equilibrium to metallurgical problems. W. Heike. *Metall v. Erz*, October (2), 1924, pp. 469–482 (in German). An explanation of Parkes' process of desilvering lead.

The thermal conductivity of the most important industrial metals and alloys. M. Jakob. *Z. Metallkunde*, September, 1924, pp. 353–358 (in German). Includes tables showing the influence of temperature on the conductivity.

The relationship between tensile strength, temperature, and cold work on some pure metals and single solid solutions. D. H. Ingall. *Metal Ind.* (*Lond.*), October 17, 1924, pp. 371–376.

IRON AND STEEL.—Notes on the history of iron and steel. G. E. Thackray. *Trans. Amer. Soc. Steel Treating*, October, 1924, pp. 443–490. A compilation of the salient points of historical note.

Steel under the oxyacetylene flame. A. S. Kinsey. *Trans. Amer. Soc. Steel Treating*, October, 1924, pp. 515–524. Heating and melting steel without oxidation or loss of its constituents.

Possibilities of producing malleable iron and intermediate products of value in short annealing periods. A. Hayes and W. J. Diederichs. *Trans. Amer. Soc. Steel Treating*, October, 1924, pp. 491–498. Outline of methods for producing malleable iron in 31 hours or less.

Pickling of iron and steel; a bibliography. Part III. V. S. Polansky. *Blast Furnace and Steel Plant*, September, 1924, pp. 431–434.

Magnetic steel, with particular reference to the relation between the carbon content and the magnetic properties. G. Hannack. *Stahl v. Eisen*, October 9, 1924, pp. 1237–1243 (in German).

The influence of cobalt and vanadium on the properites of high-speed tool steel. W. Oertel and F. Pölzguter. *Stahl v. Eisen*, September, 25 1924, pp. 1165–1169 (in German).

ALLOYS.—Some engineering applications of high-chromium-iron alloys. C. E. MacQuigg. *Metal Ind.* (*Lond.*); Part I, September 26, 1924, p. 310; Part II, October 3, 1924, pp. 332–334.

Electrolytic formation of alloys and amalgams of manganese. A. N. Campbell. *Chem. Soc. Trans.*, September, 1924, pp. 1713–1719. Laboratory preparation of manganese amalgam and of alloys of manganese with nickel and iron.

Light alloys. A general survey of modern practice. J. B. Swan. *Automobile Engineer*, October, 1924, pp. 293–300. A comprehensive account of the latest developments in the application of light alloys in automobile engineering.

The new aluminium-silicon alloys. J. D. Edwards and R. S. Archer. *Chem. Met. Eng.*, September 29, 1924, pp. 504–508. Description of the aluminium-silicon alloys obtained by treatment with metallic sodium or a flux containing sodium fluoride.

"Stainless" chromium steels. W. H. Hatfield. *Chem. Met. Eng.*, October 6, 1924, pp. 544–546. Data as to their behaviour in contact with corrosives encountered in chemical engineering.

ANALYSIS.—Selective determination of vanadium in the presence of iron and chromium. Part I. Estimation of vanadium in the presence of iron. K. Someya. *Z. anorg. u. allg. Chem.*, September 26, 1924, pp. 237–245 (in German).

Rotating-anode apparatus for rapid electrolytic analysis. L. Bertiaux. *Ann. Chim. Analyt.*, September 15, 1924, pp. 257–264 (in French). A new apparatus for the electro-analysis of metals.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

DREW-BEAR, PERKS AND CO., LTD., London, S.W., ironfounders. Registered October 10, £22,000 prior lien debenture, to A. E. Messer and another, 14, Old Jewry Chambers, E.C., solicitors; general charge. *£15,000. December 31, 1923.

TOWLER (WILLIAM) AND CO., LTD., Leeds, ironfounders, etc. Registered October 3, £3,000 debentures; general charge. *£7,000. September 27, 1923.

Satisfactions

DREW-BEAR, PERKS AND CO., LTD., London, S.W., ironfounders. Satisfactions registered October 9, £10,000, registered August 21, 1924; also registered October 11, £500, part of amount registered March 4, 1904.

TOWLER (WILLIAM) AND CO., LTD., Leeds, ironfounders. Satisfactions registered September 24, £8,500 part of amount registered August 16, 1907, and £1,000 registered March 18, 1910.

London Gazette, &c.

Companies Winding Up Voluntarily

CALLIM METALLURGICAL CO., LTD. G. Chich, secretary of the company, appointed liquidator. October 3.

DUNSTAN STEEL CORPORATION, LTD. J. W. Massey, chartered accountant, 46, Cherry Street, Birmingham, appointed liquidator. October 9.

Underground Contracts

THE contracts placed in connection with the extension of the London Underground Railway from Clapham Common to Morden and from Charing Cross to Kennington have resulted in a large amount of work for iron and steel manufacturers. Work on these railways has now been started. No fewer than 90,000 tons of iron tunnel-lining segments will be needed, and contracts to this amount have been placed in the Middlesbrough district and in Nottinghamshire, while the 2,900 tons of bolts and nuts required for fixing the segments are being made at Wolverhampton. Of steel running rails and contact rails orders totalling 2,000 tons have gone to Middlesbrough and to Leeds, whilst contracts for the necessary fishplates and fishbelts have been placed in South Wales and Birmingham. Cement will come from the Kentish and South Essex Cement Works, glazed tiles and bricks from Staffordshire and Leeds. Since the existing scheme of development and improvement was inaugurated some three or four years ago, the Underground has been instrumental in developing in this country the manufacture of pneumatic shovels and other tools that were previously only obtainable abroad.

Rustless Steel Ball Bearings

WITH the object of developing a ball bearing which would be rust-resisting some tests have been conducted by the S. K. F. factory in Sweden on balls and races made of stainless steel. The bearings used were of the self-aligning type, and were run in a testing machine at a speed of 1,000 r.p.m. at varying loads to determine their carrying capacity. After the tests, which were of long duration, the fact was revealed that rustless balls had only about 10 to 20 per cent. the carrying capacity of the usual ball bearings. It was also found that the rustless steel balls were far inferior to hardened chrome steel balls, and were only slightly superior to bronze.

It seems obvious from these tests that stainless steel ball bearings are not yet commercially practicable, though the general opinion is that well-designed stainless steel rolled bearings may be used where the load is not too heavy and where rust-resisting properties are essential.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

The Time Factor in Metallurgy

Difficulty of Obtaining Average Time Figures for Different Processes

Our contributor in the following notes comments on some recently published figures of the average times for "fettling" and "charging" steel furnaces, and adds some valuable figures applying to a particular works.

FIGURES are notoriously the most kittle cattle with which a man can plough. Words are bad enough, as it requires a deal of practice to make the plainest statement, or to express the simplest fact in terms that shall be entirely free from ambiguity. When it comes, therefore, to a "mixed" expression involving both words and figures, there are no end of traps and pitfalls for the unwary. These reflections, for which no striking originality is claimed, are called forth by two simple examples culled from the technical Press, or rather, that part of it which is devoted to metallurgy and engineering. One refers to the length of time which it takes, on the average, to "fettle" an open hearth steel furnace.

A Multiplicity of Factors

Obviously, the actual time taken in fettling a given furnace, in given circumstances, will depend on a multiplicity of factors; it should not, however, be difficult to state, over a reasonable number of furnaces and charges, the "average" time. It may, and probably will be, misleading; it may mean little or nothing, but it should, at least be capable of expression. As a matter of fact, even this proves to be a task beyond the capacity of a mere human being to discharge. It ranks with another question: how long—again "on the average"—does it take to work a charge? Correct answers to these two questions would be invaluable. It would be possible, by their means, to obtain information respecting a host of useful facts. Cost sheets could be checked and fuel economy accurately determined. Without them it would become almost impossible to answer so apparently simple a question as "what is the potential steel-producing capacity of this, or of some other country?" Another example is afforded by attempts made, from time to time, to define certain terms. A very expert International Committee was appointed, some years ago, to define certain —apparently—simple industrial terms. One of these was "steel." Quite recently Professor Sauveur, who is a recognised and widely known authority, has given a fresh definition of steel. The definition propounded by the International Committee was far from faultless. Professor Sauveur's is worse. It may therefore be concluded that there are certain questions to which no simple answer can be given, and certain things which are simply not capable of definition. Both issues have sufficient interest for metallurgists to warrant closer examination, but as the latter has quite recently been discussed in these columns, it is only the former which need here be considered.

"Fettling" and "Charging" Times

The Industrial Fatigue Research Board recently published a report in the course of which it was stated that the "average" time of fettling varied from 27 minutes to 203 minutes. It is difficult to know what to make of such a statement; the most that can be said of it is that the Board was ignorant of what the word "average" really means. Our esteemed contemporary, "The Engineer," commenting on this report, expressed the view that in any well organised works, half an hour usually sufficed for this operation; that 203 minutes would imply a bad bottom, and dryly remarked that with one possible exception "no member of the Board was really conversant, in any practical degree, with the practice and technology of iron and steel making." Dr. H. M. Vernon raised the standard of defence, and in his rejoinder states that 203 minutes was the "mean of 381 fettlings (observed in summer time) whilst another 390 fettlings (in winter time) gave an average of 184 minutes." To turn now to the question of "average" charging time. Harbord's well known work on "Steel" is silent on the subject. Carnegie, in his "Liquid Steel" gives 7½ to 8 hours for charging a 25-ton basic open-hearth furnace, half cold pig and half scrap, the context implying hand-charging, and quotes an instance, abroad, of machine-charging cold pig, 50 tons, in 20 minutes. There are not many 25-ton furnaces left, and much of the pig iron in the present day is charged molten. What are the "average" times of fettling and charging? To be precise, in this conflict of testimony, what is "fettling" and what is "charging"?

Modern Steel Works Practice

Not all the time which elapses between tapping the charge and commencing to charge the new charge is spent in fettling. From a pedantic point of view, oreing and pigging back

DATA OF (ABOUT) 77 CHARGES—ALL MACHINE-CHARGED.

Furnace.	P	A	B	C	D	E	F	G
Time from commencement of charging to tapping	11 hrs. 45 min.	14 hrs. 19 min.	11 hrs.	9 hrs. 40 min.	13 hrs. 30 min.	11 hrs.†	12 hrs.† 30 min.	11 hrs.† 45 min.
Number of charges per week	—	10	12	14	8 to 9	11 to 12	10	10
Working hours per week	—	138	140 to 144	146	133	148	142 to 145	139
Time unaccounted for (*a*)	—	minus 4 hrs. 50 min.	8 to 12 hrs.	11 hrs.	11 hrs. 30m. to 25 hrs.	16 hrs. to 27 hrs.	17 hrs. to 20 hrs	21 hrs. 30 min.
Average "fettling" time deduced from (*a*)	1 hr.* 52 min.	nil	40 min. to 60 min.	47 min.	1 hr. 25 m. to 3 hrs. 8 m.	† 1 hr. 45 m.	1 hr. 42 m. to 2 hrs.	2 hrs. 9 m.
Nature of charge (tons)	30 hot 30 scrap	20 cold 36 scrap	52 hot 12 scrap	21 hot 21 scrap	64 cold 53 scrap	31 hot 19 scrap	30 hot 30 scrap	23 hot 40 scrap
Amount of charge (tons)	60	56	65	43	117	50	60	65

* Actual time, Parkgate heat. † Averaged.

might be regarded as "Charging" operations. Actually, with a good furnace bottom, a good previous working, and smooth running, fettling (the operation of effecting repairs to the bottom) will only occupy a short time. Half an hour is about right. A bad bottom is not, happily, "average" practice. It is usual, however, to regard the time between tapping out, and beginning to charge, as "fettling" time. "Charging time" can conveniently be regarded as the time consumed in feeding the furnace with the whole of the materials of the charge. Pig iron used for pigging back, and ferromanganese, or spiegel additions to the bath, are not part of what is understood (except pedantically) by "the charge." The operations involved are subsidiary and contemporaneous to the "working" of the charge. Some useful and up-to-date information is forthcoming as to British practice in respect of the two phases, fettling, and charging. It is to be derived from one of Mr. Fred Clement's illuminating papers read before the Iron and Steel Institute. Yet, even here, there are traps for the unwary. Mr. Clements, in the schedules to his paper on "British Siemens Furnace Practice," gives full details relating to average charges in 9 modern furnaces, one of which is a Talbot continuous furnace, which, for the immediate purpose in hand, can be ignored. In the case of one of his own (Parkgate) furnaces the time schedule is actually divided up into "fettling" "charging," "melting" and "working." In the other instances the "fettling" times are not given, and can only be deduced from the data supplied. The table on the previous page has been based on the figures available.

The curious result of furnace "A" where the time for working 10 charges from commencement of charging to tapping exceeds by nearly 5 hours per week the total hours worked per week, apparently, leaves no time for fettling at all. The period from tapping, to commencement of charge, which, for convenience is to be regarded as fettling time, varies in the other cases from 40 minutes to 3 hours 8 minutes and may be said to average, for 77 charges, one hour and eight minutes, taking the "A" furnace charges into consideration, or 1 hour and twenty minutes without them. The explanation of the "A" furnace result is, of course, that the fettling time has really been included in the whole time from charging to tapping, which obviously vitiates the charging times given for this furnace. From these figures, which represent modern practice "averaged" "The Engineer" contention that 203 minutes does not represent "average" practice receives substantial support. They also show how futile any attempt at statements respecting averages become, when the behaviour of such unlike units as a 117-ton furnace, charged cold, and a 43-ton furnace, charged hot, are, for statistical purposes, compared together.

Cadmium Amalgams: Properties, Preparation and Uses

By N. F. Budgen, Ph.D., M.Sc.

THE cadmium-mercury alloys or cadmium amalgams are members of that class of alloys in which the two metals are completely mutually soluble when just liquid, but only partially soluble when just solid, and the two branches of the liquids curve (Fig. 1), intersect in a point which lies above the freezing point of one of the pure metals.[1]

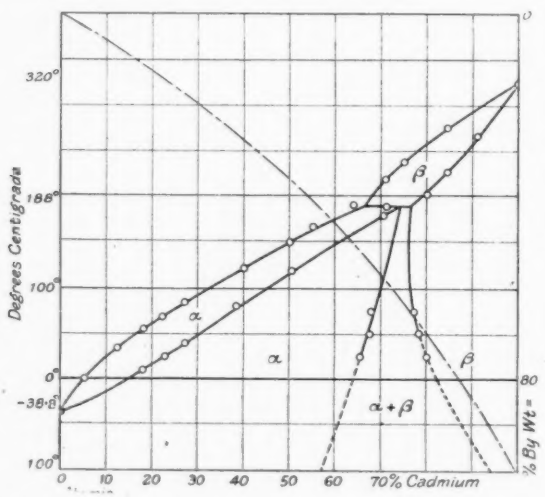


FIG. 1.—CONSTITUTIONAL DIAGRAM OF MERCURY—CADMIUM ALLOYS.

The liquidus[2] has been determined very accurately by two independent sets of thermal observations, and to locate the solidus the changes of volume of the alloys during cooling have been observed by means of a dilatometer. The somewhat scanty data for the solubility lines was obtained from measurements of electro-motive-force. The transition temperature is at about 188° C. (370° F.), and the limiting concentrations of the two solid solutions at this temperature are shown on the diagram as 62 and 67 per cent. of cadmium respectively. These points cannot be regarded as very accurately determined.

[1] Gulliver, "Metallic Alloys," 1921. Griffin and Co.
[2] Bijl, H., *Zeit. Phys. Chem.*, 1902, Vol. XLI, p. 641, and Puschin, N. A., *Zeit. Anorg. Chem.*, 1903, Vol. XXXVI, p. 201.

Heat of Amalgamation of Cadmium

The heat of amalgamation of cadmium is 505 cals. and that of zinc 2,255 cals. The contact e.m.f. between cadmium and amalgam is only 0·05 volt, while between zinc and its amalgam the contact e.m.f. is not appreciable.[3] The solution and diffusion in mercury of cadmium has been investigated by Humphreys.[4]

Electrical-Conductivity and Vapour Pressure

The electrical conductivity of cadmium amalgams, measured at different temperatures, shows that with more than 1 per cent. of cadmium present the conductivity increases with temperature, first quickly then more slowly until a transition point is reached at which the conductivity becomes rectilinear. Increased concentration raises the temperature of the transition point. For very dilute amalgams, the conductivity between 0° and 20° C. may be represented by quadratic equations.[5]

The vapour pressures of cadmium amalgams at 324° C. have been measured over the whole range of concentrations.[6] The curve of cadmium falls below the line corresponding with Raoults' Law, and may be satisfactorily accounted for by assuming that molecules of a compound Cd Hg are formed.

Applications of Cadmium Amalgams

Standard Cells.—Perhaps the best known use for cadmium amalgams is their employment in connection with standard cells.

For purposes of standardisation and testing a cell is required the e.m.f. of which is constant and independent of all local conditions. A standard cell of very constant e.m.f. is the Weston Normal Cell. Fig. 2 shows it as made up in the H-pattern. One limb contains cadmium amalgam, the other mercury covered with a paste of mercurous sulphate. The whole is filled with a solution of cadmium sulphate kept saturated by inserting in each limb some crystals of cadmium sulphate which crust together and form, as it were, plugs below the constrictions of the tubes. The e.m.f. is 1·0183 volts at 20° C, but falls by 0·00004 for a temperature rise of 1° C.

Cadmium amalgams may be solid, liquid or a mixture of solid and liquid phases, the percentage composition of the phases depending on the temperature. When a completely liquid amalgam is cooled below the lower transition temperature the centre of the resulting solid is of high cadmium con-

[3] Richards, T. W., *Zeits. Phys. Chem.*, 1899, Vol. XXVIII, p. 1.
[4] Humphreys, *Journ. Chem. Soc., T.*, 1860.
[5] Calvo, A., *Journ. Chem. Soc.*, 1911, A. II, p. 575.
[6] Hildebrand, J. L. *Journ. Amer. Chem. Soc.*, 1920, Vol. XLII, p. 545.

centration and the outer skin of low concentration. Diffusion tends to produce uniformity and in consequence the e.m.f. of a cell containing the amalgam, is unstable for a considerable length of time. When the amalgam is slowly cooled to a temperature a little below the lower transition temperature, the difference of concentration between the inner and outer parts of the amalgam need be only small to enable the outer skin to be a two-phase system.

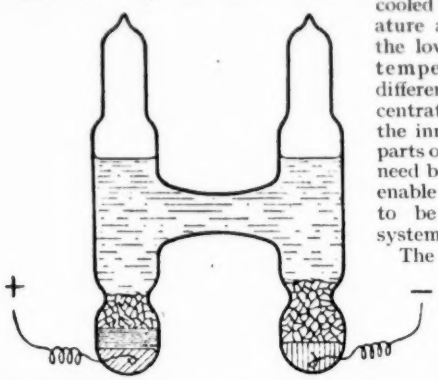


FIG. 2.—STANDARD CADMIUM CELL, H-PATTERN.

The diffusion process may be slow, and the e.m.f. may remain constant for a very long time. Amalgams of uniform cadmium concentration throughout have been obtained by chilling completely liquid amalgams to a temperature of about — 50° C., although not initially stable rapid diffusion processes resulted in these amalgams becoming approximately uniform throughout after a few days and their electro-motive properties are markedly different from those of slowly-cooled amalgams. If, however, the temperature of such an amalgam is raised, until two phases exist, subsequent cooling will not restore the uniform condition and an unstable amalgam results.

Experiments indicate that a 12·5 per cent. amalgam may be safely used at all temperatures between 12° and 60° C., and a 10 per cent. amalgam at all temperatures between 0° and 51° C. Experiments made on the temperature co-efficient of the anode and cathode limbs of the Weston Normal cell show that if a temperature difference of 1° C. exists, an error of about three parts in 10,000 is introduced.

Preparation for Commercial Uses

Vickers[7] speaks of a pure cadmium amalgam as consisting of Cd_5Hg_8 by which is probably meant a composition by weight of five parts cadmium and eight parts of mercury, which is not what would be inferred were the expression the symbol of a chemical compound.

For the preparation of the actual amalgam the mercury is heated nearly to the boiling point in a crucible and then the cadmium is added in the form of thin sheet. The amalgam remains soft for some time and only becomes crystalline after a considerable period. The mass obtained by heating is, therefore, allowed to stand in the crucible until the excess of mercury separates out; or it can be separated in the ordinary manner by squeezing in a chamois bag. The amalgam forms a tin-white or silver-white mass which softens on being moderately heated and can be kneaded like wax.

Cadmium Amalgams for Dentistry

The cadmium amalgam referred to by Vickers (*loc. cit.*), has in the past been used in dentistry for filling teeth, either alone or with other metals which make it still more suitable for the purpose. An addition of tin or bismuth renders it more pliant under heat, and for this reason the mixture generally used for filling teeth was frequently composed of amalgams containing several metals.

A few of such compositions are given below. Those containing lead, however, are not to be recommended, as the metal is poisonous and is attacked by organic acids, even when in the form of an amalgam :—

DENTAL AMALGAMS.

	Per cent.	Per cent.	Parts by Weight.		
Cadmium	25·99	21·74	1·0	1 to 2	3
Mercury	74·01	78·26	—	—	—
Tin	—	—	2·0	2·0	4
Lead	—	—	—	7 to 8	15

[7] "Metals and Their Alloys." Crosby, Lockwood and Co., 1923.

The first amalgam is well adapted for filling teeth as it acquires in time such hardness that it can be worked in the lathe or with the file, and, of course, becomes hard in the mouth. The setting of dental amalgams is attributed to the greater insolubility, at atmospheric temperatures, of the solid solution rich in mercury, as compared with the solid solution rich in cadmium. And since the alloy does not diminish in volume, the stopping remains tightly fixed in the cavity.[8]

It has been stated that the use of cadmium amalgams for dental purposes is now no longer general on account of the discolouration which they produce in the dentine of the tooth. The metal becomes converted in small degree into the yellow sulphide, thus forming a brown stain, so that the use of cadmium amalgams has, in high class dentistry, been abandoned for palladium amalgams which do not so stain the dentine. For cheaper work, however, it is probable that the mixtures indicated above are still to some extent employed. Cadmium amalgams being very ductile can be used for a variety of other purposes.

Amalgams containing 33·3 per cent. of cadmium and 66·7 per cent. of mercury, and those containing equal parts of cadmium and mercury are extremely plastic, and can be rolled or beaten into the thinnest foil, they are silver-white and constant in the air.

Evans's Metallic Cement

This alloy is obtained by dissolving a cadmium amalgams consisting of 25·99 parts of cadmium and 74·01 parts of mercury in an excess of mercury, slightly pressing the solution in a chamois bag and thoroughly kneading.

By kneading, especially if the amalgam be previously heated to about 35° C., this cement is rendered very plastic and, like softened wax, can be wrought into any desired form. On cooling it acquires considerable hardness, which is, however, not equal to that of pure cadmium amalgam.[9] Another amalgam composed of mercury 78·25 per cent. and cadmium 21·75 per cent., which corresponds to the formula of the intermetallic compound Hg_2Cd, is hard and brittle.[10]

Review

THE SCIENCE OF METALS. By Jeffries and Archer. New York: McGraw-Hill Book Co. Pp. 460. 25s.

The development of the use of metals in the present stage of civilisation has necessitated a systematic study of their structure and properties, and very valuable work has been done on this line in England, America, and on the Continent. Books have been published which have become classics in the several branches of metallography, but it has been left to two American metallurgists to present, in the book which we have before us, a survey of the researches over the whole field.

The authors are well qualified by training and experience to undertake such a survey, and Mr. Jeffries particularly is well known among metallurgists by the excellent work he has done, They do not break new ground but confine themselves to a review of the latest knowledge. The book is based largely on the investigations of English—and to a less extent of American —metallurgists, and includes much of the most recent work of Rosenhain, Bragg, Carpenter and Elam, and others. That it is quite up-to-date will be seen from the comprehensive treatment of the phenomena of crystal growth and the X-ray investigations of the structure of crystals.

This book is evidently intended as a text book for metallurgical and engineering students. Parts of it already published have been used in some colleges for purposes of instruction. It will be equally useful to those engaged in the practical production and use of the various metals. The information is presented clearly, without being too involved, and the theories expounded are well illustrated by practical examples as well as by numerous photographs and tables.

T. W. E.

[8] Lowry, T. M., and Widing, S., *Journ. Soc. Chem. Ind.*, 1920, Vol. XXXIX, p. 110.

[9] Referred to above as Cd_5Hg_8.

[10] *Ency. Brit.*, 9th Ed., Vol. IV., p. 628.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Tenacity of "Era" Steel

In reference to the paragraphs on "Era" and "Hecla" steel, Principal Douglas H. Ingall, M.Sc., A.I.C., A.Inst.P., of the County Technical College, Wednesbury, writes:—

"I was interested to see in your Metallurgical Topics (p. 36 of your last issue, November 1, 1924) a statement with regard to 'Era' steel possessing a tenacity of 15 tons per square inch at a temperature of 900° C. I have nothing to say against this steel, but I thought that in the metallurgical world we had now got to the state when we realised that a figure for high temperature tensile strength was only of use when the conditions of the test were fully specified. I do not doubt the possibilities of 'Era' steel giving such a figure if tested at the ordinary rate of tensile test, but I should very much doubt whether this steel would maintain a load of 15 tons per square inch *continuously* at a temperature of 900° C. It is the factor time which is all important, especially to the engineer who requires a figure at which he knows his material will not 'creep.'"

We have referred this matter to Hadfields, Ltd., makers of "Era" and "Hecla" steel, Sheffield. The data in so limited a notice as that which Principal Ingall refers to obviously could not include full particulars of the characteristics of this new steel, and the tenacity figure given was only intended to serve as a simple indication of the strength of "Era" steel at high temperatures. A full description of the qualities of this steel would involve an article of many pages.

"Your correspondent," Hadfields, Ltd., state, "is correct in saying that a knowledge of the 'creep stress' is necessary to the engineer in calculations affecting the use of steel for work at high temperatures. Realising this, the characteristics of 'Era' steel in this respect had been determined, and the limits in values observed, below which there is no sustained creep, were as follows:—At 500° C. 19 tons; 600° 17 tons; 700° 11½ tons; 800° 7 tons. The figure mentioned in the article, however, was obtained in the ordinary manner of making tensile tests, the test occupying, from commencement of loading to the fracture of the bar, only a few minutes. It will be seen, therefore, from these figures whether, under conditions of rapid loading or of sustained load, 'Era' steel exhibits remarkable strength."

Heat Losses in Metal Mixers

Interesting particulars are now available relating to a research carried out at the Hagondange Steelworks, as part of a general study of heat losses from the instant when pig iron is run out of the blast furnace to its delivery at the converter. The pig iron in question was basic, and the metal mixer was a hydraulically tipping cylindrical vessel of 1,100 tons capacity. The heat balance established was based upon the known temperature of the molten metal before and after passing through the mixer. The pig ladles were of 12 to 15 tons capacity and travelled distances varying from 300 to 800 metres from the furnaces to the mixer, into which they were poured, after skimming the slag and being hoisted a vertical distance of about 15 metres. The ladles were weighed before and after pouring. The metal withdrawn from the mixer, which was fired by unheated coke oven gases, was similarly checked and weighed. The gas supply was metered. The mixer lining was silica brick covered with magnesia brick, and the average supply of pig iron to the mixer was 600 to 800 tons per 24-hour day. The mixer was only full on Mondays, when the Sunday charges had been stored up. The investigations were, in order to equalise the disturbing causes of week-ends, taken over a continuous period of 59 days. Tables and curves of the result were plotted, all the chemically reactive agents being duly taken into consideration. The average temperature at which the molten metal was poured into the mixer was 1353° C., and that of the metal poured out of the mixer for use in the steel converters 1278° giving an overall temperature loss of 74° C These figures agree well with the theoretical requirements established by the balance sheet, and show the mixer to be not inefficient.

Synthetic Pig Iron for Foundry Purposes

Many successful attempts have been made of late to supplement shortages of pig iron by charging large quantities of steel scrap into blast furnaces. During the war this was done in France and in Italy, and the practice is still being carried out in Russia, which is suffering from a "pig" famine. On the other hand, so-called synthetic pig iron cannot be satisfactorily produced in a cupola owing to the inability to obtain, consistently, a metal of high carbon content, the excessive slagging and its consequent troubles, the large proportion of coke required and the consequent introduction of a relatively large amount of sulphur, and the large loss of silicon by oxidation. In the electric furnace carbon contents of from 3·5 to 4·0 per cent. can be easily obtained. Practically any class of ferrous scrap can be used, which may be in the form of fine turnings or borings, or heavy sections. The best carburising materials are artificial electrode or resistor carbon, petroleum coke, gas retort carbon and pitch coke. Ferro silicon or high silicon iron is best for introducing silicon, although silicon carbide in the form of "firesand" has proved both cheap and effective and is also valuable as a carburiser. Any alloy of manganese and iron is satisfactory for the introduction of manganese. If desulphurisation is required, either lime or limestone mixed with fluorspar should be used. The use of silica in the slag must be avoided to obtain rapid introduction of carbon. The electric furnace need not be of a specialised type but of standard design that can be used interchangeably for iron and steel melting.

Blast Furnace Lines

An exceedingly valuable research has been published in a recent number of the *Revue de Metallurgie* by Mr. Derclay, on the relationship which exists between the lines of a blast furnace and the rate and manner of blowing it. The furnaces respecting which data were obtained for the factors in the various equations given were those on a basic pig iron burden in which only minette and Swedish ore were used. Ten such furnaces were involved. The furnaces are considered as belonging to one of two distinct types, the low high-diameter type and the tall low diameter type, or squat and slender lined respectively. The latter possess certain defects not always easily recognised, such as unnecessarily high pressure of blast and an undue sensitiveness to very small temperature changes. They consume, therefore, more coke in proportion to their "useful capacity" than a squat furnace of the same output. If furnaces of this type are mixed together in one plant and served by the same blast mains trouble will ensue. The two categories should be blown independently.

The general conclusions derived from the investigation, which is accompanied by tables and formulæ, are that the squat form furnace working on minette ore and producing basic pig iron is far more economical than the tall form, and that a very important relation exists between a furnace profile and the mode of driving. Emphasis is also laid on the great advantage of breaking the ore to uniform size; for Swedish and for manganese ore it is essential. For furnaces working under the conditions described, low wide lines and low pressure blast give the best possible results.

Tuyere Considerations

Mr. Derclay has also investigated the allied question of the number, shape, and position of the tuyeres and their influence on the behaviour of the furnace. The following formula gives the relation he has established between the number and diameter of the tuyeres, the daily production of pig iron, and the temperature, on the absolute scale, of the blast:—

$$w = 0{\cdot}00018 \frac{P}{nd_2} \times T$$

when w is the rate of the blast at the tuyeres in metre-seconds; P, the coke consumption in tons per 24 hours; T, the absolute temperature of the blast in degrees centigrade; n the

number of the tuyeres, and d their diameter in metres. The actual number is given by the equation :—

$$d = \sqrt{\frac{0{\cdot}00018\ P.T.}{n\ w}}$$

A diagram and tables based on these formulæ enable the various factors of the tuyere problem to be solved, and the most favourable conditions for furnace working can thus be ascertained. There is, however, a practical limit to the number of tuyeres that can be used. The water cooling expense increases greatly, and may correspond to a considerably greater coke consumption per ton of pig iron produced. Moreover, tuyere trouble rises in proportion to the number of tuyeres, and it is a mistake to assume that the larger the number the more effectively can the blast be distributed in the furnace. Instances to the contrary are given. The more tuyeres the more channels that occur, leading eventually to hanging and scaffolding.

The position of the tuyeres in relation to the hearth is very important, and rules are given for its determination as well as for their arrangement and connection with the blast. The general effect of all these considerations is exemplified by the detailed examination of the balance sheet of blast furnace working on a minette burden, and making basic pig with a coke consumption of 966 kilogrammes per ton, and a daily output of 163 tons. For purposes of comparison other heat balances are included. When, broadly speaking, other conditions are more or less identical, the effective yield and the coke consumption of a furnace will depend very largely on the proper selection of the right number of tuyeres.

This is a direct practical outcome, but the actual reasons do not emerge from a general consideration of the heat balance. To find the actual cause, for instance, of reduced coke consumption, the separate balance sheets relating to particular zones have to be considered. This is more difficult to do, but formulæ based on the known physico-chemical reactions are forthcoming which can be applied to the purpose. A number of diagrams have been plotted with this end in view. Even then the information may be incomplete and requires to be supplemented by theoretical deductions from the known data. The final section is therefore devoted to the theories elaborated by Mathesius, by the aid of which a general diagram can be drawn up which will be applicable to any kind of furnace, and can be adapted to any normal range of working conditions, however diverse. This diagram, which will show the maximum possible yield and efficiency, can be used as a standard of comparison, and serve to check the actual results obtained in practice, and to indicate how they can be improved upon.

The "So-Called" Bessemer Process

A STORY which, properly produced and suitably presented would form an admirable *scenario* for a film picture, but can hardly be accepted as a serious contribution to metallurgical history, comes, not inappropriately, from "Greensburg," Pennsylvania. It concerns one Kelly, whom Mr. J. N. Boucher (of Greensburg) acclaims as the true inventor of the process with which the name of Bessemer has been so long and honourably associated. The tale is unfolded in a stout volume of some 270 pages, 8vo, cloth gilt, entitled *William Kelly, a True History of the so-called Bessemer Process*. Herein we learn, not be it noted for the first time, that William Kelly was the first to conceive the idea "that cold air by itself could be used as fuel" (*sic*) and so was led to make steel, at Eddyville, Kentucky, by forcing a current of air through molten pig iron. The date of Kelly's discovery is not stated, but he applied for a patent in 1856.

There is plenty of evidence forthcoming that, in regard to this discovery, as in the case of so many others, experiments were being carried out, more or less simultaneously, in several countries, and it is not disputed that Kelly was, as a matter of historical fact, the pioneer of the idea underlying the process. For all practical purposes it, however, remained an idea, until Bessemer (and indeed Mushet as well) overcame the mechanical and chemical difficulties of putting it into effect. From this point Mr. Boucher switches off on to a melodramatic tale of plots and betrayals. Kelly, we are told, was assisted in his early experiments at Eddyville by two strange Englishmen, who remained with him up to the successful conclusion of his endeavours. Thereafter they disappeared, silently, and as mysteriously as they had arrived, in the night, and leaving their undrawn wages behind them. Kelly's suspicions aroused, he employed bloodhounds to track his erstwhile employés; they were traced to the banks of the river, but, thereafter, they vanished as effectively as did Eliza on the ice-floes described so graphically by Mrs. Harriet Beecher-Stowe. Living, Kelly was to look on them no more.

A London Discovery

SOME time elapsed—how long is again not stated—and news of the Bessemer invention having filtered over to America, a Mr. Z. S. Durfee was commissioned to go to England and ascertain the working details. During his visit he "picked up" a photograph of Bessemer in London, and on his return this photograph was shown to Kelly in his wife's presence. With a pious ejaculation of surprise Kelly bounded to his feet. He had discovered the photograph to be none other than a portrait of one of his two former unknown workmen! Of those two Englishmen who had stealthily stolen away on that eventful night, one was, indeed, Bessemer himself!

Mr. Boucher has marred the story somewhat in the telling of it. It is essential for the historic accuracy of such episodes that they should not be told twice—and in different ways each time. There is an earlier version of Mr. Kelly's story extant. It was recounted for, it was claimed, the first time on October 5, 1922, on the occasion of the dedication, by the Detroit branch of the American Society for Steel Treating, of a bronze tablet, at Wyandotte, to the memory of (unspecified) pioneers of the steel industry, whose first "Bessemer Steel Converter" in America had been installed there in 1864.

The earlier version was given in a speech by Mr. W. C. Kelly, a son of William Kelly, on the occasion referred to. He described it as a secret which his father had "guarded zealously" and told no one but his wife. It had been from her, some months before her death, that Mr. W. C. Kelly had heard the account of what had befallen. The men who had betrayed his father were "young" men, gracious and kindly. The episode of the bloodhounds was omitted. Nor was the story as "filmy" as Mr. Boucher's later, and revised, edition. There is the strongest negative evidence extant that Bessemer never visited America. At the time of the alleged visit he would have been 41 years of age—not a "young" man. Mr. Boucher disingeniously evades this vital point by claiming that nowhere in "Mr. Kelly's address or elsewhere" is there any reference to "young" men. This is, to put it mildly, nonsense. The report, with this statement, appears in the issue of the Cleveland *Iron Trade Review* of October 16, 1922, p. 1064. Finally, Mr. Boucher hedges, and hedges badly. He maintains firmly, and reiterates over and over again that, if it was not Bessemer himself who worked for Kelly, it was one of Bessemer's agents. He forgets that the photograph of Bessemer was said to have been identified by Kelly, and that, long as is the arm of coincidence, it is beyond the bounds of possibility that Bessemer would have selected a "double" for the nefarious task. The story is not even *ben trovato*, and, in any case, Mr. Boucher cannot have it "both ways." For film purposes, however, absolute accuracy of detail is not essential.

The Question of Casting Temperature

A DISCUSSION on the effect of casting temperature on the physical properties of non-ferrous alloys held by the West Yorkshire Metallurgical Society at Huddersfield recently, brought out some interesting opinions on present methods of conducting certain types of research. Several examples of investigations were quoted, from which unjustifiable conclusions had been drawn. Good and bad test results, which were said to be due to variations in the casting temperature, were in reality the effect of varying other foundry conditions. It was essential to standardise all other conditions before studying the effect of any one particular variable. The disadvantage of attempting to reproduce in laboratory tests all the conditions prevailing in practice was too seldom realised. It was almost impossible accurately to imitate practical conditions; and even if a close imitation were attained a slight departure in practice from the conditions of the "imitative" test upset the conclusions. The test could therefore only be of very limited value.

It would be far more useful if research workers would concentrate their attention on the root principles underlying their problems. In this particular case the viscosity of the molten metal, its thermal conductivity, volume contraction and specific heat all needed investigation.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

THE country has now settled down after the election, and we have had a month in which we might try to gauge the effect which the change in the Government would have on our trade. The most noticeable feature in the early part of the month was the restoration of confidence, which had been gradually slipping away. A more optimistic tone prevailed throughout the markets, a feeling that the worst had been seen and left behind, and that an all-round improvement in trade might be expected. So marked was this optimism that the stock exchanges experienced a miniature boom, particularly in industrial shares. At the same time there was quite an appreciable increase in buying of iron and steel, pig iron being the most favoured.

Politics and Business

The excitement has now subsided, and while it is correct to say that there is still a feeling of confidence, it is a more sober one, and, unfortunately, it is not yet being translated into actual business in the ordinary run of iron and steel products. In some of the special trades there has been a distinct quickening and a greater volume of orders, but this has been local rather than general. The steel works generally are no busier, and the competition and price-cutting to secure orders are as keen as ever. Indeed, in the last week or two there has been a considerable falling off and the works are finding it difficult to keep the mills going.

An explanation of this situation may probably be found in considering what happened at the close of last year, on the occasion of the change of Government which was then made. The mere prospect of a Conservative Government being then returned was sufficient to cause a distinct spurt in trade, and even after the election results were known the improved tone carried over into the new year, after which it gradually dwindled away until we reached a state of depression almost as bad as any we had known. Now another election has taken place,and the anticipation of December,1923, has become the realisation of November, 1924 ; but the experience of the past year is too fresh in mind to allow of any rapid movement. Consumers are in no hurry to stiffen the market by a rush of buying, and this holding back is encouraging the steel makers to keep their prices on the low level they have reached.

The general opinion seems to be that the best we may expect is steady trade for some time. It is not likely to go back, nor is there much prospect of anything in the nature of a boom. Meantime the usual seasonal influences, the approach of the Christmas holiday,may have something to do with the slackness which is evident. The new year will most likely see a more healthy condition, and makers will be satisfied if it brings a steady flow of trade.

Prices

Naturally, there has been some amount of forward buying. The number of inquiries for contracts which have been received by the steel makers shows that there is a disposition to book forward, and it is evidently the opinion of the market that there is no likelihood of a reduction in prices for the time being. Nevertheless new business is not coming out in anything like sufficient quantity to warrant any talk of a revival in trade.

It is a good thing that there has been no precipitate advance in prices in anticipation of such a revival. Past experience has surely taught the lesson that a gradual rise in prices as and when warranted by the demand is the only wise course to pursue. Following this policy, the plate makers at a recent meeting have decided that no alteration in prices should be made at present. The first care is to get a good order book and then look to higher prices.

Pig Iron Market

The pig iron market has shown the most active response to the change in conditions. In October pig iron was practically lifeless, purchases being only for immediate needs and prices were cut to the extreme. Early in November the market came to life again, and quite a brisk business was done. There was a general eagerness to buy, prices advanced 2s. 6d. per ton, and more orders were booked than for a long time past. One well known firm reported that in the first week in November their sales were the highest on record for a year or two, and their output is now sold for nearly three months. This was not an isolated case. Indeed, the general experience in the market confirmed what we have previously reported, that pig iron prices had reached such a level that no further reduction could be made without closing down furnaces, and that immediately there was any prospect of a movement in trade, pig iron would be the first to benefit. Buying has now fallen off to a considerable extent, but the market is steady, the price is maintained, and there is a fairly good flow of orders, which will no doubt broaden out in the new year.

The improvement in the cotton trade is bound to react on the pig iron market and subsequently on the steel trade. It is well known that all the cotton mills are sadly in need of new machinery, and as they are now in a position to accumulate some amount of capital, the ironfounders are looking forward to an early increase in the volume of orders, which will in turn stimulate the demand for pig iron. The requirements of textile machinery form one of the mainstays of the steel trade in Lancashire, and any improvement in that quarter will be welcomed.

Hematite iron is also much stronger. There is a fair amount of business passing, and the reduction of stocks is encouraging the hope that it may shortly be possible to re-light some of the furnaces that have been idle. The export business is better, and if some of the inquiries from the United States lead to business they will help the market considerably.

The finished iron trade has shared in the general improvement. The demand for marked bars is quite good, and the mills appear to have plenty of work. Crown bars are not so well placed, although makers report that buying has been rather better. The railway companies are still giving out useful orders for iron.

Steel billets have been comparatively active. The price of soft steel has been reduced to £7 10s. in the Midlands, although makers are trying to get more. In the Sheffield district the price is round about £8, and there has been a considerable amount of buying at that price. The Continental prices have been increased by 7s. 6d. per ton, and this has given the English billets a better chance in the market.

Finished Steel Trade

The finished steel trade is the most unsatisfactory at present. Notwithstanding the recent official reductions, prices are still being cut, in many cases to a ridiculous extent, in order to secure work ; and yet orders are scarce, so much so that the incoming specifications are not nearly enough to balance the deliveries, and makers are faced with a gradual shrinkage of order books. The desperate position of some of the works is revealed by the prices they are willing to accept ; in fact, some of the instances of price-cutting which we have found during the last few days can only be described as senseless. They spoil the market entirely, and the sooner the works which carry on this kind of thing are compelled to close down the better it will be for the trade generally. It is no wonder that we hear of so many works which are getting into financial difficulties. The price associations are useless at present. What is the good of fixing the price of, say, boiler plates at £13 or £13 10s. when makers are actually offering to supply at £11 10s. and even £11 5s. ? The official price of sections is £9 5s., but one maker only a few days ago quoted £8 17s. 6d. for a large order and then did not secure it ! Really one wonders whether it would not be preferable to have some system in force similar to that which Germany had before the war, and to which we referred last month. The existence of a central organisation for the distribution of orders might do something to put a stop to this internecine competition ; and it would put a premium on efficiency in the works.

Some good inquiries have been going round the market for steel plates and sheets for gasholders ; probably by the time this appears in print, the contracts will have been placed. Already there has been keen competition among the steel makers for this work, and whoever gets the order will have to supply the steel at below cost price.

Production Figures for October

The production figures for October are slightly better than September. The output of pig iron amounted to 586,400 tons compared with 569,200 tons in September, and 595,700 tons in October 1923. The number of furnaces in blast at the month end was 171, being one more than at the beginning of the month. The output of steel ingots and castings was 678,500 tons compared with 645,000 tons in September, and 702,200 tons in October, 1923.

There is a little better news from some of the steel making centres. The Barrow Steel Works, after being idle for some months, were able to start again on November 24 as a result of their securing a large order for steel rails from the New Zealand Government, amounting to about £100,000. Messrs. Dorman, Long and Co. have also reopened their Carlton ironworks which had been standing for about two months. A new industry has been established at Messrs. Vickers' works at Barrow-in-Furness. The company is now making winding engines for mines, and is quite busy on this work. The mechanical parts are made at Barrow, and the electrical equipment at Manchester, by the associated company the Metropolitan Vickers Electrical Co. Already they have the credit of having made the largest electrical winder in Europe, this equipment being installed at the Harworth Main Colliery, near Bawtry in Yorkshire.

Contracts

Some good contracts have been secured by the steel makers during the month. The Leeds Forge Co., associated with Messrs. Cammell Laird and Co., have received an order from the Union of South Africa for 50 all-steel bogie wagons, in addition to other smaller orders from the Colonies. Messrs. Bolckow, Vaughan and Co. have obtained an order for 24,000 tons of rails and sleepers for the Uganda Railways in British East Africa. Messrs. Cammell Laird and Co. have signed a provisional contract for the construction of a new railway line in New Zealand, involving an expenditure of about £500,000. This will necessitate the exportation of considerable quantities of machinery and materials.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Desulphurising and Sintering Ores

An apparatus for desulphurising and sintering ores has been patented by H. J. Stehli, of Cedar Grove, Essex Co., N.J., U.S.A. The apparatus is of the kind in which receptacles or pallets for the ore are arranged to travel as an endless band around a pair of sprocket driving wheels. The upper length of the track is horizontal, and the ore is fed to the pallets by a hopper at one end. The ore is ignited by means of a downwardly-directed flame, and air is drawn downwards through it by means of one or more suction boxes arranged below the pallets. In the illustration, one side of a pallet is shown at

Fig. 2

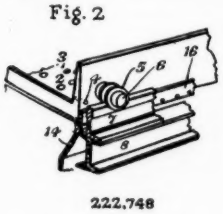


Fig. 4

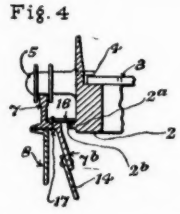
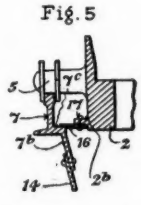


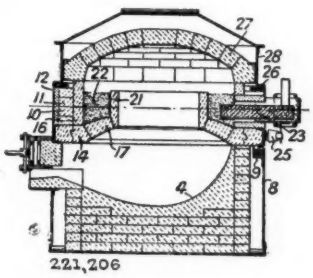
Fig. 5



2, and the perforated bottom at 3. The supporting rollers 15 move over tracks 7 supported by beams 8. The wall of the suction box is shown at 14, and an airtight joint is provided between the moving pallet and the box 14 by means of relatively soft flexible material 16, which may be secured either to the suction box or the track or to the pallet. The material may be hemp or asbestos cloth, which may be impregnated with a lubricant such as graphite. This material is drawn against the adjacent surface by the suction, and is readily replaced when worn. See Patent No. 222,748, dated February 12, 1924.

Electric Furnaces

A patent application for a resistance furnace has been made by T. F. Baily, of Alliance, Ohio, U.S.A. The furnace is heated by granular resistance material 22 contained in a trough supported by the side walls 10 of the furnace. The brickwork around the hearth 4 is surrounded by a metal shell 8 having a sand seal 9 which supports the heating trough



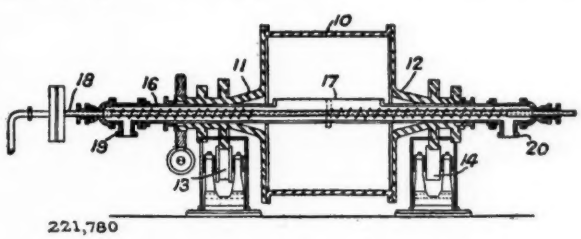
and side walls 10. The trough is formed by walls 16, 21 and a base 17, and is constructed of carborundum. The brickwork roof 27 is surrounded by a metal shell 28 engaging a sand seal 26. Current is supplied by the electrodes 23. See Patent Application No. 221,206, having the International Convention date, August 28, 1923.

Alloys

An acid-resisting steel alloy is the subject of a patent application by the firm of Poldihutte, of Kladne, Czecho-Slovakia. An example of such an alloy contains nickel 22 per cent., chromium 15 per cent., carbon 0·5 per cent., manganese 0·5 per cent., and silicon 0·3 per cent. See Patent Application No. 221,511, having the International Convention date, September 5, 1923.

Iron Manufacture

A patent application has been made by Australian Minerals Recovery Co., Ltd. (Assignees of Copper Separation, Ltd., Perth, Australia) for a method of producing sponge iron. A rotary furnace 10 is mounted on trunnions 11, 12, supported on roller bearings 13, 14. A screw conveyor mounted on a shaft 18 passes through the trunnions and the furnace, the surrounding tube 16 being provided with a launder 17. The



tube 16 is turned so that the inlet 19 faces upwards to receive a charge of ore and carbon. The shaft 18 is then rotated to feed the charge into the furnace 10, and the inlet 19 is closed by a valve. The furnace is then heated and rotated continuously for the necessary time, when the shaft 18 is again rotated and the reduced material discharged through the launder 17 to the outlet 20. See Patent Application No. 221,780, having the International Convention date, September 15, 1923.

Alloys

An application has been made by F. Thuand and Soc. Anon. Electro Metallurgique de Montricher, Paris, for a patent for an alloy for making cheap material for magnetic purposes. Iron is refined to a substantial purity in an electric furnace, and additions are then made of manganese 0·04–0·07 per cent., silicon 3·5–4·2 per cent., nickel 0·05–3 per cent., and titanium 0·5–1 per cent. The sheets are decarbonised by annealing with powdered magnetic oxide of iron so that they contain 0·02–0·05 per cent. of carbon. See Patent Application No. 222,088, having the International Convention date, September 22, 1923.

Chromium Alloys

Two inventions relating to chromium alloys have been patented by W. Borchers, of Aachen, Germany, and R. W. Stimson, of New York. In these inventions a refined alloy of iron with any desired proportion of chromium, molybdenum, or uranium, with or without a third metal, is obtained by using as the refining agent a superoxygenated artificial solid solution containing chromium, molybdenum, or uranium. These refining agents are obtained by roasting under oxidising conditions an intimate mixture of one or more compounds containing chromium. molybdenum, or uranium, and a metallic oxide having basic chemical properties, such as the oxides of calcium or magnesium. The components are crushed and bound together before roasting by a hydrated solution of a carbonate or hydroxide of an alkali or alkaline earth metal. This mixture is roasted in the presence of excess of oxygen or air. This artificial solid solution may itself be reduced by any of the known metallic and metalloidal deoxidising agents, except carbon, to yield an alloy of iron with chromium, molybdenum, or uranium. See Patent No. 223,617, dated April 24, 1923, and February 12, 1924, and Patent No. 223,622, dated April 27, 1923, and February 22, 1924.

Iron-Manganese Alloys.

An iron-manganese alloy having great strength and toughness, and also sufficient ductility to enable it to be drawn or rolled into wire has been patented by A. C. Hyde, of London, and W. L. Turner, of Caldy, Cheshire. These qualities are obtained by using iron containing only 0·02–0·15 per cent. of carbon, and commercial carbon-free manganese, and by avoiding any introduction of carbon during the process of manufacture. The alloy is produced by reducing manganese oxide and iron oxide by means of heat produced by the alumino-thermic process. The two oxides may either be mixed together and treated, or the manganese oxide may first be reduced and then mixed with the iron oxide and melted by this process. The alloy is particularly suitable for use in a welding rod in an electric, oxy-acetylene, or other system of welding, as it introduces manganese into the weld without also introducing carbon. See Patent No. 223,626, dated June 21, 1923.

Current Articles Worth Noting

We give below a brief index to current articles in the technical press dealing with metallurgical subjects.

CORROSION.—The action of salt solutions on iron and steel in the presence of oxygen. U. R. Evans. *J.S.C.I.*, October 31, 1924, pp. 315–322T. Study of the action of drops of solutions of different salts on iron, showing how some salts stimulate and others reduce corrosion.

ALUMINIUM.—Aluminium and its alloys. Part II. The working of aluminium. Part III. Corrosion and protection of aluminium. *Metal Ind.* (*Lond.*), October 31, 1924, pp. 421–422, and November 14, 1924, pp. 475–476.

CHROMIUM.—Chromium—its uses and alloys. Part III. W. M. Mitchell. *Blast Furnace and Steel Plant*, November, 1924, pp. 504–507. Discusses the reducing effect of chromium upon the thermal conductivity of steel and its importance when heat treating large forgings.

ZINC.—Investigations relating to electrolytic zinc. M. v. Schwarz. *Metall* v. *Erz*, November (1), 1924, pp. 499–504 (in German).

ALLOYS.—Stellite and similar alloys. E. H. Schulz. *Z. Metallkunde*; Part I., September, 1924, pp. 337–343; Part II., October, 1924, pp. 382–387 (in German).

WORKING OF METALS.—Fluxes and slags in metal melting and working. Introduction—The physical chemistry of slags and fluxes in then on-ferrous metal industries. Part I., Melting and smelting. Part II., Slag inclusions, welding and soldering. *Trans. Faraday Soc.*, August, 1924, pp. 113–208.

ELECTRO-DEPOSITION.—The repair of worn components by electro-deposition. J. P. McLare. *Trans. Faraday Soc.*, August, 1924, pp. 87–96. Description of the war-time development of iron and nickel electro-deposition in the repair of worn parts of machinery.

The structure of electro-chemical deposits. M. R. Audubert. *Rev. Métallurgie*, October, 1924, pp. 567–584 (in French). A discussion of the influence of various factors upon the character of metallic deposits.

Studies on electro-plating. Part IV., Anodes, their functions and dissolution. W. E. Hughes. *Metal Ind.* (*Lond.*), November 21, 1924, pp. 491–493 and p. 496. Includes a table for the diagnosis of the ills of plating baths from the aspect of the anodes.

IRON AND STEEL.—X-Ray tests applied to the problems of the steel foundry. H. H. Lester. *Trans. Amer. Soc., Steel Treating*, November, 1924, pp. 575–605. Examination by X-Rays for detection of casting defects and its influence upon casting technique.

The cementation of iron by silicon. R. T. Haslam and L. E. Carlsmith. *J. Ind. Eng. Chem.*, November, 1924, pp. 1110–1113. The influence of various factors upon the siliconization of iron.

ANALYSIS.—Applied methods of estimating antimony in ores, slags, alloys, etc. *Metal Ind.* (*Lond.*), November 28, 1924, pp. 515–516.

Critical investigation of the determination of silicic acid in ores, slags, fluxes, and refractories. A. Stadeler. *Stahl v. Eisen*, November 20, 1924, pp. 1477–1481 (in German).

Estimation of manganese in metallurgical products. L. Bertiaux. *Bull. Soc. Chim.*, October, 1924, pp. 1335–1351 (in French). Describes an exact method for determining large or small quantities of manganese.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of* 1908 *provides that every Mortgage or Charge, as described therein, shall be registered within* 21 *days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an* *—*followed by the date of the Summary, but such total may have been reduced.*]

ALUMINIUM CORPORATION, LTD., London, S.W. Registered October 29, £7,950 and £8,250 B debentures, part of £250,000; general charge. *£760,060. November 22, 1923.

CONSETT IRON CO., LTD. Registered November 17, Trust Deed dated October 31, 1924 (supplemental to Trust Deed dated June 14, 1922), securing £1,000,000 1st debenture stock, ranking *pari passu* with £1,500,000 secured by principal Trust Deed; general charge. *£1,500,000. July 10, 1924.

DODD AND OULTON, LTD., Liverpool, brassfounders. Registered October 18, £10,000 debentures; general charge. *£15,000. May 10, 1923.

LUTON IRON FOUNDRY, LTD. Registered November 7, £6,000 debentures; general charge.

SMITH AND COVENTRY, LTD., Salford, ironfounders. Registered November 3, £3,000 and further advances up to £7,500 further charge (created by receiver of company) to Norwich Union Life Insurance Society, Norwich; charged on property comprised in 1st and 2nd debenture Trust Deeds. *£115,000. October 31, 1923.

STOREY FOUNDRY CO., LTD., Heaton Norris. Registered November 7, £1,000 debentures (filed under section 93 (3) of the Companies (Consolidation) Act 1908), present issue £900; general charge.

WILLIAMSON (JOSEPH) AND CO., LTD., Wellingborough, ironfounders. Registered October 16, £11,000 debentures; general charge.

Satisfactions

COCHRANE AND CO. (WOODSIDE), LTD., Dudley, ironfounders. Satisfaction registered October 31, £30,000, registered January 12, 1907.

LUTON IRON FOUNDRY CO., LTD. (Old company). Satisfaction registered November 14, all moneys, etc., registered December 14, 1923.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., 8, Bouverie Street, London, E.C.4. All communications relating to Advertisements, Subscriptions and other business should be sent to the Manager "The China Clay Trade Review," at the same address. Telegrams—"Allangas, Fleet, London." Telephone—City 9852 (6 lines)

Contents

PAGE
EDITORIAL NOTES 7–8
Wembley and the Paper Industry 9–10–11
Tehidy Minerals, Ltd. 14
American Clay Deposits Re-opened 15
The Functions of Paper Fillers 16
Notes and News 17–18
Shipping and Export News 19–20

A Warning from America

THE article we publish in this issue from the American journal *Paper*, giving an account of the development of an American China Clay works, makes interesting reading, and once more calls attention to the efforts which are being made to advance the American clay business, both with regard to the opening up of new pits and the improvement in production methods.

This country has enjoyed for many years past a very large trade with the American paper mills and potteries. We shall probably continue this in the future, especially with our better brands of China Clay; but the article is reprinted with the object of drawing attention to what is going on across the water, and shows that if this valuable American market is to be retained, renewed efforts must be made by our own producers on this side to convince our friends of the U.S.A. that English China Clay is the superior of any in the world and that our terms and dispatch can be relied upon.

Americans have frequently been down to the China Clay producing areas of Cornwall and Devon with the object of purchasing our pits and works for their own requirements. Possibly the time has come when our producers may be interested in purchasing some of the American pits, for although the American clay may not be the equal of the English clay, yet for some purposes it answers their requirements. With the knowledge and experience gained in production methods, English producers might conceivably improve the quality of the American clay and keep the trade in their own hands.

The methods of refining and drying of China Clay in the United States have been very crude in the past, although great strides have been made within the last few years. Some years ago we published some photographs of an American pit and dries, by which out readers saw that the methods of production were very different from an English works. The difficulties of working the pits at Vermont, as described in our article, are also very apparent. The fact, however, remains that in spite of our increased trade with America the sale of American China Clay has also increased at a very extensive rate, and it is as well to understand and appreciate this development, not with any fear of being ousted from the American market, but as showing that the mills and potteries of the States have need of, and are purchasing, more clay than we are supplying from this country.

The American producer is "on the spot," and is keen to sell his clay. It may be that at present we can supply by water at a cheaper rate to some States than the American producer can by rail, but this may not always be so. It is therefore necessary for our producers to watch America and not let slip any opportunity for the development of trade there, especially so now that so much of our continental trade has been lost through the Great War.

Then and Now

BEFORE the War English China Clays were sought for by manufacturers from all parts of the world, and to-day are superior to other countries' kaolins, with perhaps the exception of one other European country, whose clays may be said to equal some of the better Cornish clays. In spite of this being so one has to recognise the fact that the production of English China Clay is to-day from 100 per cent. to 150 per cent. above the demand for it. This may be to some extent accounted for by the unsettled rate of exchange of European countries, but it does not in itself explain why this very serious state of affairs should exist. With a view to finding out the opinions of producers themselves we have been making some enquiries, and naturally they do not all agree on some points. As a whole, however, the results show that given more security against labour troubles, the present fear of foreign buyers that at any moment their supplies from England may be held up by strikes would vanish, and thus give that confidence to buyers which means increased trade. That this fear of strikes in England is real can be confirmed by the writer, who on a recent visit to America found it one of the reasons why domestic clays were developing.

One English producer, who strongly expressed his feeling upon the matter, was of opinion that producers and royalty owners should organise their respective interests so that the industry could be worked as one financial interest, and that labour should modify their present demands, and give a guarantee of freedom from disturbance for a period of years.

There is certainly food for thought in these opinions, and we have more than once suggested that it might be to the interest of royalty owners to combine interests with producers. The royalty owners have everything to gain by the increase of trade in the China Clay industry and undoubtedly recognise this fact, but we think that the time has come when both the producers and royalty owners have seriously to think of the best and wisest means of seeing that the trade shall not slip away, but on the contrary shall increase considerably. That this can be done we are convinced, but it will not be done unless serious thought is brought to bear by all interested parties on ways and means for the future.

Colloidal Clay and Propaganda Work

WE have had many inquiries as to the uses of colloidal clay, and the subject appears to interest both producers and consumers of China Clay. We have endeavoured to give as much information as possible on both the production and use of this finely divided clay, now known as "Colloidal China Clay." As far back as 1921 we were publishing articles on this subject, and we have seen its use in soaps, rubber, paints, and for medicinal purposes. That it has not made further headway is perhaps due to

its present high cost. The distinct advantages gained by the use of colloidal clay for certain purposes should not be overlooked by consumers, even if the cost is greater. We do not see how the price can be reduced, as the manufacture of colloidal clay in some cases is a complicated and costly proceeding. Many thousands of pounds have been sunk in plant for the preparation of this colloidal clay by China Clay producers, and consumers may now purchase the finest colloidal China Clay that may be required.

Although there are now several firms producing "colloidal" China Clay, we think a more vigorous advertising campaign would do much to help the sale of this clay, which, being entirely free from grit, should find many uses.

It has already been pointed out that it is only possible to give information of a general character as each clay has to be treated separately, and producers who are thinking of placing a colloidal clay upon the market would be well advised to obtain the advice and help of experts before embarking upon costly experiments.

Care must be exercised by the purchaser, as "colloidal clays" have been offered for sale which have been very deficient in active colloidal properties.

Of course for some purposes—the manufacture of sulphate of alumina, alum, etc., or as a cheap filler—the ordinary commercial China Clay is quite satisfactory, but for more refined uses only the gel form is really suitable.

Six Months' Trade

THROUGH the falling off by over 24,000 tons of the China Clay trade done in June compared with the splendid volume dealt with in May, the statistics of total trade for the six months are not so good as was anticipated in May. Nevertheless, taking into consideration the dislocation of trade in the first two months of the year and the difficulties encountered of doing business in European markets through the uncertain political position, the total figures for the six months are not discouraging.

At the end of June the figures for this year have reached 414,235 tons against 423,357 tons for the corresponding six months last year, and 432,184 tons for the first six months of the post-war "boom" year of 1920. Seeing that this year's figures do not include shipments of ball clay, whereas the figures of last year and in 1920 included them, this year's figures are at least 15,000 tons better than they appear to be on the surface, and that being the case this year's total volume of trade is over 5,000 tons better than a similar period last year, and only 3,000 or 4,000 tons below the corresponding six months of 1920. Therefore, despite the falling off now being experienced, the first six months of this year have been very satisfactory considering the factors operating, to which we have referred. Of the total trade done in the six months, 312,893 tons have been export, nearly two-thirds of which were accounted for by the American markets. At the time of writing this article, the dissected export figures for the whole six months are not available, but the figures for the five months are as follows:

January.	Total export	71,833	tons	(U.S.A. 41,193)
February.	,, ,,	32,637	,,	(U.S.A. 18,582)
March.	,, ,,	44,535	,,	(U.S.A. 27,696)
April.	,, ,,	41,532	,,	(U.S.A. 24,493)
May.	,, ,,	74,438	,,	(U.S.A. 48,855)

Total exports for five months, 264,975 tons (U.S.A. 160,819).

The dropping off of deliveries in June, which is also being experienced in the current month, is largely due to the lessened demand from America, where the Presidential elections always have a very depressing effect upon the imports into that country, where the demands of consumers have been largely anticipated by the heavy shipments that have been made up to the end of May.

Hydraulic Working of China Clay

Its Advantages and Possibilities

THE problem of operating China Clay works hydraulically appears to involve two distinct periods or phases. Firstly, hydraulic working virgin soil with plant following the gradually sinking pit bottom, and secondly, hydraulic working on lowest level, mining away on approximately horizontal plane. During the first period it is considered best to use an electrically-operated centrifugal pump designed for pumping the mixture of water, clay, and sand set in motion by the hydraulic jets operated from a suitable nozzle pump arranged on bank level, the latter pump to draw in the usual way from the clay settling basin. This sand pump would lift the mixture of clay, water, and sand from the pit bottom up to the paddock on the bank. Here another centrifugal pump would receive the clay and water and lift it up to the settling tanks, the sand having previously been removed in the paddock or hopper boxes. This procedure would advantageously be adopted down to a depth of the pit bottom of, say, 30 feet, or thereabouts. Now the paddock, or paddocks, would be lowered to and rigged up at this intermediate level while the sand pump feeding these boxes would again follow the sinking pit bottom until, say, 60 ft. below tank level. Should the mine require still further lowering, the paddock would now be lowered to, say, 60 feet from bank. The sand pump would follow the further sinking pit bottom and so forth. From the paddocks the waste sand would be hauled by trolley or aerial ropeway to the sand dump.

Sand Pumping *v.* Trolley Transport

Bearing in mind that the sand pump is less efficient than the clay water pump and considerably less efficient than trolley transport, it is obvious that an appreciable saving would be effected as compared with schemes involving sand pumps designed for lifting during the whole period of sinking from pit bottom to a paddock situated on bank. In addition, the life of the sand pump is increased very considerably, due to this reduction in total lift (or pressure), while the life of the clay water pump is not adversely affected to any appreciable extent. Against the method recommended above would have to be charged the cost of lowering the paddock, say twice, by 30 feet each time, but it is considered that the net result would be a distinct saving of money. Incidentally, the original cost and the weight of the sand pump, its motor and hut, would be reduced substantially. The removal of the plant during sinking operations would thus be facilitated. In order to obviate the use of a sand pump the paddock boxes can be lowered continuously along with the sinking pit bottom, rigging them up sufficiently low to permit of the tailings being gravitated from the face washed by the hydraulic nozzle.

Although wear and tear of the sand pumps is necessarily rather high, the wages spent on lowering and rigging up the cumbersome paddocks so frequently would exceed the cost of renewals of the sand pump materially.

Hydraulic Work on Lowest Level

When the mine has reached its maximum depth, that is, when hydraulic operations are carried out on about constant level, thus widening the pit radially, the system recommended is paddocking the sand at pit bottom, raising it by trolley or aerial ropeway, and pumping the clay and water from which the sand has been separated in the paddock straight up to the clay settling basins. Thus the sand pump, which must always be subjected to considerable wear, is done away with. The same system would certainly be recommended for work during the first period as well were it not for the large amount of work requiring to be spent upon the frequent removal of the paddocks.

Whether a Cornish or centrifugal pump be used for dealing with the sand does not affect the question of wear materially. As to the capacities of sand, clay and nozzle pumps, the larger they can be made the better, both in regard to efficiency and wear of the individual machines. Factors that operate in deciding on hydraulic China Clay working are local conditions, such as size of settling basins, size of drying plant, and the question of continuous work at the pit—matters which have, of course, to be considered individually in every case.

With reference to the pressure at which the hydraulic jet should be operated, it is not possible to give a hard and fast rule, as it naturally depends upon the nature of the ground treated. For most cases it is safe to provide for an effective pressure of 90 to 110 lbs. per square inch, measured at the nozzle.

Wembley and the Paper Industry

To all interested in the China Clay industry, one of the most interesting sections of the British Empire Exhibition will be that devoted to the paper making trade. A comprehensive survey of the section appears in *The Paper Makers' Monthly Journal*, by whose permission the following interesting information and illustrations are reproduced.

The principal exhibit is the paper making machine which is to be found in the Palace of Industry. It is not too much to say that this machine, which is something more than a model in its way, is probably one of the most striking exhibits, and this is confirmed by the crowd of visitors constantly to be found looking at the machine whilst in operation.

The machine is to be seen working at Stand U 853, in charge of the Paper Makers' Association of Great Britain and Ireland.

Visitors are informed that during the exhibition the plant will be used to illustrate the manufacture of various classes of paper as made by firms who are members of the Association.

The paper machine is capable of producing a sheet of paper 30 in. wide at a speed of 100 ft. per minute. For want of adequate space, the two beating engines have been installed on an elevated platform. This unfortunately deprives the public of the opportunity of seeing how the raw material is treated before the beaten stuff runs on to the machine. The whole installation is large enough to produce paper on a practical scale, and at the close of the Exhibition there should be fairly keen competition amongst technological institutions for acquiring the plant as it stands.

Almost every firm in the United Kingdom manufacturing paper machines or machinery required in the erection of a paper mill seems to have been pressed into service.

Raw Material

The principal raw material used for the manufacture of paper with the Exhibition machine is wood pulp, though other fibres find their special uses, and the search for various raw materials suitable for paper making suggests a visit to other parts of the Exhibition, and thought naturally turns first to Canada. It is not too much to say that the Canadian Pavilion is one of the most magnificent and attractive shows in the Exhibition, and the extraordinary ingenuity with which the whole of the productions of Canada are displayed does credit to the architect and designer, and is undoubted evidence of the desire of the authorities to give Canada its due position as a source of raw material. Paper and pulp naturally occupy an important position. The extraordinary growth of the industry is represented by reels of newspaper, one of which has been sent from the Laurentide Pulp Mills, manufactured on a machine having a width of no less than 220 in. There is also a model of a mechanical pulp mill showing the forest, the river with its waterfall, water power development, the mill town, railway sidings, the whole making a striking exhibit, having been constructed under the direction of the Forest Products Laboratory of Canada. In one section of the Pavilion is to be found a magnificent series of show cases representing the many varieties of paper and paper products manufactured in Canada. One of these cases contains a large number of textilose products such as paper bags, carpets and wall tapestries made by the Textilose Co. of Trafford Park, Manchester, from Canadian kraft paper.

The importance of the Canadian pulp and paper industry can be gathered from a special pamphlet issued for distribution at the Exhibition. The information given is as follows: —Number of mills in operation, 104; pulp mills, 43; paper mills, 33; pulp and paper mills, 28; capital invested, $381,006,324; employees—female, 1,190; male, 24,640 (exclusive of woods operations). Wages and salaries, $32,918,955; value of products, $192,033,364.

Production—Mechanical pulp, 1,241,185 tons; sulphite pulp, 687,878 tons; sulphate pulp, 217,862 tons; other pulp, 12,326 tons.

Newsprint—1,081,364 tons; book and writing, 64,805 tons; wrapping, 81,793 tons; boards, 113,200 tons; other paper, 25,650 tons.

Pulpwood consumed—2,912,608 cords, valued at $40,375,599, of which spruce, 2,032,985 cords, valued at $29,265,555; balsam, 627,626 cords, valued at $8,189,407; hemlock, 157,947 cords, valued at $1,766,729; pine, 79,461 cords, valued at $940,278.

Materials used in the manufacture of pulp—Sulphur, 87,556 tons; limestone, 89,706 tons; lime, 73,165 tons; soda ash, 1,050 tons; bleach, 15,401 tons; sulphate of soda, 6,811 tons; salt cake, 40,487 tons.

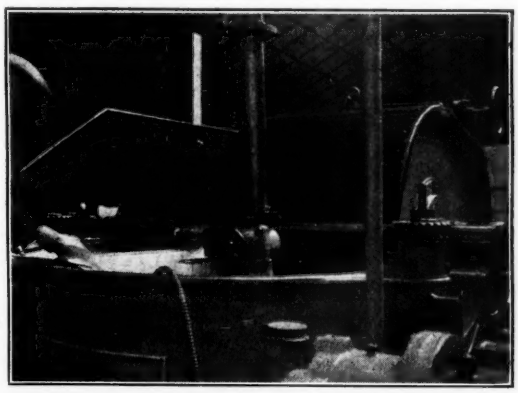
Materials used in the manufacture of paper—Groundwood pulp, 925,761 tons; soda fibre, 2,414 tons; sulphite fibre, bleached, 29,201 tons; unbleached, 307,642 tons; sulphate fibre, 56,356 tons; rags, etc., 13,290 tons; old or waste paper 70,915 tons; other paper stock, 23,146 tons.

Fuel consumed—Bituminous coal, 1,389,118 tons; anthracite coal, 91,793 tons; fuel oil, 10,304,143 gallons; wood, 73,006 cords. Total fuel cost, $13,000,457.

One of the most interesting sections of the Empire Exhibition is that representing Newfoundland. The displays are eloquent of the importance of this country in supplying pulp and paper to Great Britain. The wood pulp industry is well within the range of resources and facilities in Newfoundland, and has a promising future in the country, where the exportation of pulp wood is prohibited by law. It is a well recognised fact that serious inroads are being made upon forest supplies the world over.

This has a reflex influence on the value of Newfoundland forests and water powers, and indicates a great future for the pulp industry in this country. Newfoundland spruce has been found to make wood pulp equal to the best, and superior to most productions on the market, and bears a favoured reputation. Water powers are available in many localities within reasonable convenience to wood supply, and while the number of large powers is limited, there are many smaller powers available where the cost of development is proportionately low compared with the larger powers. The full value of her forest wealth will only accrue to Newfoundland when the paper mill and the box board mill are found in conjunction with the pulp mill, and the water powers are utilised in this industry to such an extent that the export of paper will show at least 300,000 tons per annum.

The market for wood pulp is readily found, either in Europe or the United States. At this distance from the mother country Newfoundland is at a disadvantage as compared with the Scandinavian countries, which supply the bulk of wood pulp to the British market, and preferential arrangements between Great Britain and her colonies should have regard to the immense business in wood pulp which Great Britain at present extends to European countries, with a view to directing the current of supply and demand more surely within the Empire, within which both supply and demand most certainly exist.



BEATING ENGINE USED FOR THE WOOD PULP SUPPLIED TO THE PAPER MACHINE.

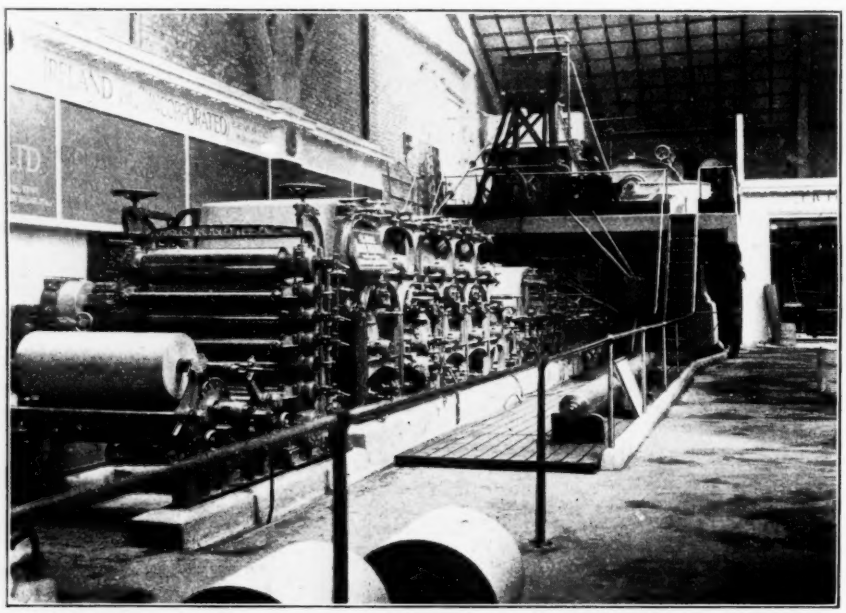
Australia

Although the Commonwealth of Australia does not make any direct exhibit of woods and fibres suitable for paper making, yet in their attractive exhibit of timber some indirect reference is afforded by the Information Bureau in the display or a scientific bulletin entitled "The Manufacture of Pulp and Paper from Australian Woods." The newspaper proprietors

of Western Australia presented the Institute with a small paper-making machine capable of producing a continuous strip of paper four inches in width. The preliminary trials were carried to a conclusion by some practical experiments made at the mill of the Australasian Paper and Pulp Co. Under these circumstances the most appropriate methods of treatment were readily ascertained and it was found that satisfactory papers could be produced by using 60 per cent. Australian hard wood.

The commercial possibilities of establishing a pulp industry depends largely on available markets. The local needs of Australia are comparatively small, and the idea of an export market seems rather far-fetched. The Forestry Commission of Australia estimates over 4,000,000 cords of pulpwood in Victoria alone, half of which is within 100 miles of Melbourne. Lack of material is no longer any argument against an export trade. Moreover the wood suitable for pulp can be regarded as a waste forest product. Examination of the conditions under which a mill could be established in Australia to produce 5,000 tons of printing paper per annum from Australian pulp, supplemented by a little sulphite pulp imported, indicates that local pulp would probably be available at about £15 per ton in Melbourne, compared with £23. The cost of steam for drying the pulp and paper would be reasonable having regard to the class of fuel burnt and the economies to be effected by the use of modern plant. The rate of wages paid in Australia would be no greater than in other pulp-producing countries. Hence manufacturing conditions should not stand in the way of ultimate development of the industry.

The bulletin mentioned is printed on paper made by the Institute of Science and Industry during the semi-commercial tests described therein. It contains 60 per cent. of chemical pulp made from Australian eucalyptus, 30 per cent. of imported chemical pulp, and 10 per cent. of waste paper. The eucalyptus wood contains 56-60 per cent. of total cellulose. The importance of the timber industry of Australia for local purposes is admirably shown by the accompanying photograph.



VIEW SHOWING THE CALENDERS AND REELERS. BEATING ENGINE AND PREPARING ROOM ON AN ELEVATED PLATFORM.

Burmah

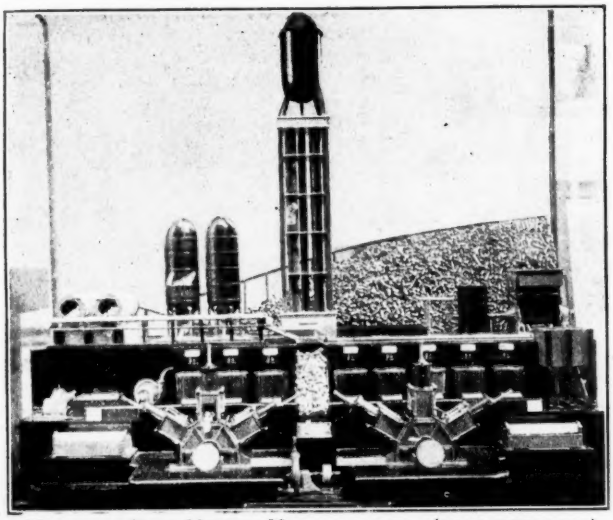
Attached to the Burmah pavilion was a fine collection of the many varieties of bamboos growing in this particular part of India, varying from the small sticks of one inch diameter to huge cylindrical canes of the well-known type having a diameter of no less than five or six inches. There was an interesting series of samples of pulp and paper made by native workmen in the Shan States from the well-known Broussonetia Papyrifera. This is a bast fibre of extraordinary length and toughness, and yields, even under the crude methods employed in the native States, a strong and tenacious paper. No fewer than fifty species of bamboo are adaptable to the manufacture of paper.

Considerable attention has been given in Burmah to the exploitation of the bamboos, woods, and cereal grasses. In 1906 Mr. R. W. Sindall visited the country on behalf of the Indian Government and issued a report upon the possibilities of the vegetable fibres, showing that not only was the raw material of excellent quality, but that the supplies were for all practical purposes inexhaustible. Since that date W. Raitt, cellulose expert to the Forest Research Institute, Dehra Dun, has issued the results of extended investigations into the application of bamboo and savannah grasses. Bamboo now finds a regular place as a raw material for paper making. The average condition of Bamboo is represented by the following analysis, which gives a comparison of bamboo with other pulp producing fibres.

	Water Extract.	Fat and Wax.	Pectose.	Lignin.	Cellulose.	Ash.
Melocanna Bamboo (2nd year)	13·57	1·70	12·77	21·73	51·23	2·25
Bhabur Grass	9·08	2·64	35·57	3·40	49·31	6·20
Wheat Straw	7·79	1·24	29·06	10·23	51·68	2·70
Spruce Wood	6·73	3·02	0·0	35·76	54·49	0·05

India and Malay States

No special attention was paid to the display of wood and fibres suitable particularly for paper making in the pavilion devoted to India, but there was a good display of jute and other fibres suitable for textile purposes. Nevertheless during the last few years considerable attention has been shown in the direction of the cultivation of Indian grass and fibres for paper making not so much for export as for use in the country, the present tendency of Indian policy being in the direction of making the country self-supporting in all its industrial operations. In one corner of the pavilion devoted to Malay products, paper receives special attention in the display of bamboo and other materials suitable as raw material for paper making. The exhibit includes small bales of half-stuff manufactured from bamboo and from napier grass (*Pennisetum perpureum*). There are also some stout fibre and leather boards made from grass and bamboo half-stuff and strengthened by rubber latex prepared by the Kayes Rubber Latex Co.



MODEL OF PULP MILL IN NEWFOUNDLAND (ENLARGED VIEW)

South Africa

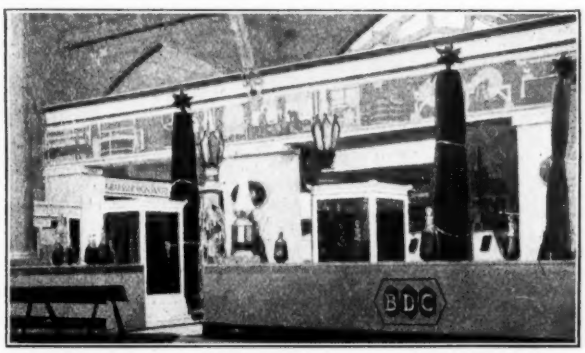
The pavilion devoted to South African products gives an indication of the progress in paper making by a small display of paper made from the mimosa bark by the Premier Paper Mill Co., of Johannesburg, described as the first and only paper mill in South Africa, situated at Klip River, Transvaal. The samples shown illustrate the wrapping papers made from this material. The authorities responsible for the industrial development of South Africa have shown much enterprise and skill in the encouragement of the use of native products, and the attention given to the manufacture of paper pulp from mimosa, the wattle bark, and similar raw material, is only one instance to the extent to which industrial concerns may rightly expect technical advice and assistance from those able to give it.

New Zealand

Although New Zealand is plentifully supplied with timber, this is mostly of the hard wood variety and is employed almost exclusively for building and domestic purposes. Experiments have been made as to the possibility of utilising New Zealand woods and the pulp obtained was all of good quality. The establishment of paper mills in New Zealand depends more upon such practical considerations as freight, cost of wood and material delivered to a given site; and investigations so far do not encourage the idea of a paper and pulp industry in New Zealand. Contributions to the successful running of a paper mill are to be seen both in the Palace of Engineering and the Palace of Industry. The close relations of one industry to another are always fairly obvious, no trade being self contained or self supporting. The raw materials for the production of a sheet of paper are by no means confined to rag, wood, esparto and other fibrous substances. Coal for power, steam for drying, gelatine and rosin for sizing, dyes and pigments for colouring, chemicals for treatment of fibre, machinery for motive power and transport are all required in no mean quantity. Hence in any exhibit of an industrial character one may find objects of importance and interest to paper manufacturers.

The Palace of Engineering

The authorities of the Exhibition claim that the Palace of Engineering is the largest of its kind, constructed of concrete, in the world. Its size may be visualised in the idea that it occupies six times the area of Trafalgar Square. It probably contains the largest display of general engineering ever assembled under one roof. It would be almost impossible to select a list of engineering firms from the catalogue for special mention, seeing that most of those more directly concerned with the paper trade have identified themselves with the miniature machine, by supplying the necessary parts and equipment, as their share in the Exhibition as a whole.



BRITISH DYESTUFF CORPORATION, LTD. A FINE DISPLAY OF COLOURED FABRICS.

"PAPER" EXHIBITS IN THE MALAYAN PAVILION.

Many displays of importance to the paper trade appear in the Palace of Industry. Probably the average visitor finds more here to appeal to his sense of attraction as the objects on show are of a simpler domestic character. The admirable manner in which the objects are classified makes the task of sight-seeing easier than might at first be anticipated, for the number of exhibits is so bewildering that the seeker after knowledge may well be excused from an attempt to master everything. Chemicals used in paper making are well shown by Brunner, Mond and Co. and the United Alkali Co. In collaboration with the former are to be found such well-known firms as the Buxton Lime Co., Castner-Kellner Alkali Co., Chance and Hunt, Ltd., Electro-Bleach and Bye-Products, Ltd., Synthetic Ammonia and Nitrates, Ltd. Their exhibits include soda ash, soda caustic, soda silicate, bleaching powder, liquid chlorine, sulphur and other chemicals. The display of the United Alkali Co. is a striking lesson in the art of window dressing. Matter of fact and uninspiring powders and liquids with lifeless appearance take on a new and fascinating aspect when put in attractive phials and arranged gracefully in glass cases with their glittering shelves. The chief case is more than a mere collection of chemicals, a successful attempt being made to give an object lesson in the uses to which the products are put in the manufacture of articles of domestic importance.

The British Dyestuff Corporation, Ltd., have followed the same line of action in their fine display of fabrics, papers

(Continued on page 14)

English China Clays, Ltd.

ST. AUSTELL
CORNWALL
ENGLAND

Phone:
182 St. Austell

Telegrams:
Universal, St. Austell

THE LARGEST CHINA CLAY PRODUCERS IN THE WORLD

LONDON OFFICE:

59, 60 Chancery Lane, W.C.2

Telephone: Holborn 577

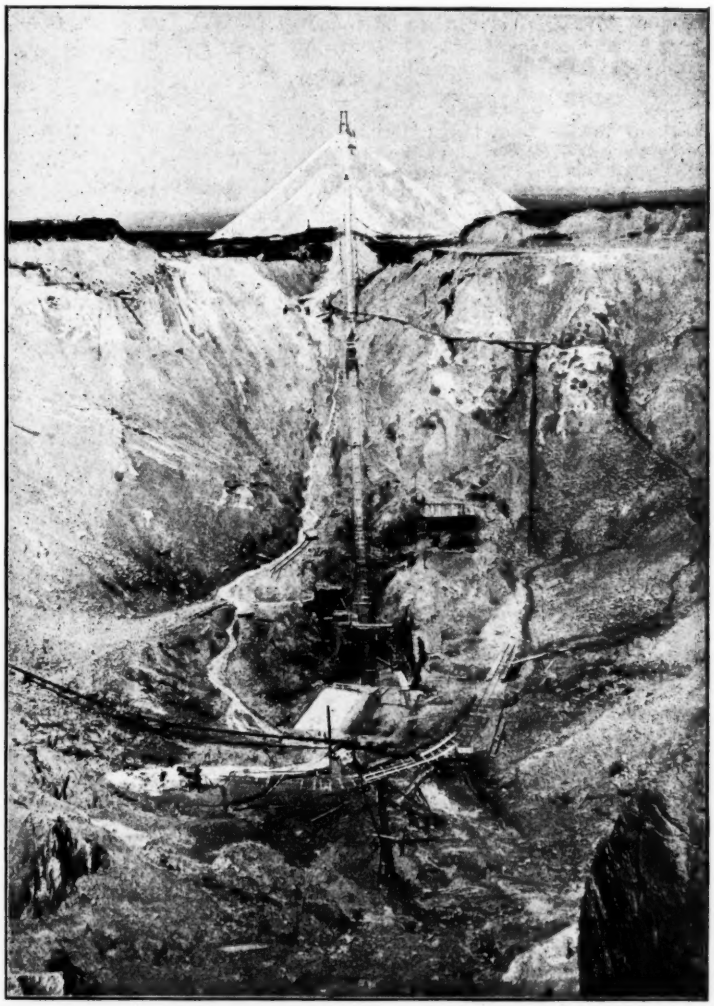
MANCHESTER:

Northern Assurance Buildings, Albert Square

English China Clays LTD.
St. Austell
Cornwall

EDINBURGH:
4a St. Andrew Square

PLYMOUTH:
Laira Wharf, Prince Rock



CLAYS for the PAPER MAKER

NOTED FOR THEIR

RETENTION · COLOUR · PURITY

Numerous grades for filling and coating. Qualities suitable for all kinds of paper, from costliest "Art" to cheapest "News."

(Continued from page 11)

and finished goods which are shown to illustrate the ultimate purpose of the many-coloured powders manufactured by them and duly exhibited. The progress of the dye industry may be judged by the statement in the Exhibition guide book that while in 1913 80 per cent. of the dyestuffs used in this country were obtained from abroad, to-day we produce for ourselves all but 20 per cent. of our requirements.

Other dye firms represented are L. B. Holliday and Co., Ltd., of Huddersfield, and Hickson and Partners, Ltd., of Bradford; British Alizarine Co., Ltd., of Manchester; Grays Dyes and Colours, Ltd., of Grays, Essex. Laboratory and scientific apparatus is splendidly shown by Baird and Tetlock, and is an attractive exhibit. The chemistry of paper making in these modern days is receiving the attention to which it is entitled, and paper makers are beginning to appreciate the fact that the services of a chemist spell economical production, solution of technical difficulties, and regular running of mill operations under their control. The application of scientific principles, whether of mechanical, electrical or chemical order, is not only desirable but inevitable, and no manufacturer can afford to ignore the truism.

British Chemical Science

The Association of British Chemical Manufacturers has arranged a department which is of special value in illustrating

"A Corner in Research." Cellulose and Cellulose Products.

the result of research in pure and applied chemistry. Prominent amongst the show cases, which are all of great interest even to a passing visitor who examines the exhibits with a desire to learn something, will be found several relating to the subject of cellulose, mounted, arranged, and associated with the name of C. F. Cross, Esq., F.R.S., whose world-wide reputation as the pioneer of chemical investigation of cellulose and its derivatives is known to all paper makers. The exhibits illustrate the products of viscose, viscose silk, esparto, esparto wax, pulp and other derivatives obtained from the black liquors obtained from the soda treatment of esparto and similar fibres. The walls of the section are covered with portraits and engravings of eminent chemists who, though dead, have left lasting memorials of their greatness behind them.

The use to which the finished product can be put is not represented by a large number of firms. T. B. Ford and Co. have a display of blottings and filter papers in a well-arranged stand found in the section devoted to paper, printing, stationery and maps. Messrs. R. Fletcher and Sons, Ltd., give a fine display of tissues, cigarette papers, and copying papers. There is no doubt that the special products of the mills controlled by Messrs. Fletcher and Sons have a world wide reputation and compare very favourably with any similar makes from other countries. Messrs. T. H. Saunders and Co. have a unique show in the exhibition of a series of watermarks, well arranged round the stand and so displayed that the transparency is easily seen.

At Stand 277, close to the Bessemer Gate of the Palace of Engineering, the trade and technical journals have opened a well-arranged Bureau, where trade visitors to the Exhibition can consult in comfort the current journals of the particular industry in which they are interested, with a linguist in attendance for the supply of information to the foreigner.

Tehidy Minerals, Ltd.

China Clay Prospects of the Company

At the fourth annual general meeting of shareholders of Tehidy Minerals, Ltd., held at East Pool Mine, Carn Brea, Cornwall, on June 28, the chairman, Mr. H. Montagu Rogers, J.P., had some interesting things to say about the China Clay prospects of the company. Tehidy minerals have large interests as lessors in metalliferous mining in West Cornwall, notable lessees being East Pool and Agar, Ltd., and South Crofty, Ltd., but it is in regard to their interests and that of their directors in China Clay mining that our readers will be interested. As producers as well as lessors they are interested in the operations of the Halviggan China Clay Works, near St. Austell, which they acquired a few years ago from Messrs. H. D. Pochin and Co., Ltd., and in Cornish Kaolin, Ltd., which company have recently made extensive developments both in their works on Bodmin Moors and their kilns at Bodmin Road Junction. Varcoes China Clays, Ltd., are the sole selling agents of the whole of the output of both Cornish Kaolin and Tehidy Minerals. Messrs. C. A. Moreing and A. H. Moreing, who are financially interested in both these companies, being among the directors of Varcoes China Clays, Ltd., of which Mr. C. S. Varcoe is managing director.

Halviggan China Clay Works

In moving the adoption of the directors' report and statement of accounts, the chairman said: "You will observe that the property account, including the purchase of Halviggan Clay Works, stands at £313,775 6s. 5d., an increase of £1,292 6s. 7d. The additional expenditure includes improvements of the general equipment of the clay works. The stocks on hand of clay and stores stand at £5,558 11s. 1d., being an increase of £271 8s. 11d., and the liquid resources stand at £15,565 2s. 1d., exclusive of investments on the debit side of the account. The issued and paid-up capital remains unaltered, but the loan secured by temporary debentures shows a reduction of £2,167 11s. 10d. The preliminary expenses now stand at £2,586 5s. 10d. only, a reduction of £747 11s. 6d. having been made therefrom, and the sundry creditors and credit balances show a reduction of £2,208 18s. 3d. All outstanding liabilities are charged up and included in the statement of accounts.

"Referring to the profit and loss account, the revenue from mineral dues and rents amounted to £5,423 17s. 4d., showing a small gain of £302 1s. 9d. over the previous year. The amount received from clay sales was £5,727 15s. less than 1922, but the stocks of clay at the end of 1923 represented more in value by £675 4s. 6d. than 1922. The smaller sales of clay are responsible for the lessened revenue from the clay works, but I am glad to say the general administration and sales expenses and interest on loans were about £1,500 less than 1922, and it is our endeavour still further to reduce same.

"The profit for the year amounted to £1,564 18s., to which must be added the credit balance brought forward from 1922, £1,160 19s. 1d., making a total of £2,725 17s. 1d. Deducting from this sum the corporation profit tax for 1922, and balance of underwriting commission written off, together accounting for £475 0s. 8d., leaves a credit balance of £2,250 16s. 7d., which it is proposed to carry forward to the next account.

China Clay Properties

"There has been no change in our China Clay properties under grant, which are yielding satisfactory revenues. As regards our Halviggan Works, our sales were less than in 1922, because we had not the accumulated quantity to dispose of in 1923 as we had in the previous year. However, the credit balance from the trading account of these works is responsible for the credit balance shown in the profit and loss account. The refining plant has been enlarged, and various alterations made in the settling tanks to secure a finer product and economic working. One has every reason to believe that these works will yield a steady and in all probability an increasing revenue.

"It is about six years ago we acquired a goodly heritage of mineral rights extending over, or rather in and under, some 30,000 acres in Cornwall, famous for its mineral wealth. These still await exploitation and development, which the slump and general depression have hitherto prevented.

Trade is surely, if only slowly, on the mend ; the price of tin has recovered, and is now satisfactory to good mines ; arsenic is a helpful by-product and the clay trade is promising and progressive. With these facts before us I look forward with confidence that the results of the present year will be a great improvement on the last. My justification for this statement is that the revenue earned this year from rents and royalties is more than double that earned for the corresponding period of last year, and our expenses are less."—Mr. Oliver Wethered, seconding the resolution, said the chairman had given them some interesting facts and figures, and had conveyed to everybody that a distinct improvement had commenced in the various undertakings in Cornwall from which that company would share the benefit directly or indirectly. What it had cost them in Cornwall generally in the past, due to the various causes, it was difficult to estimate ; " but our direct loss of income is very many thousands a year. There are a great many shareholders in this company now who probably do not remember the conditions under which we purchased what our chairman has described, and I think even now is correctly described, as ' a goodly heritage.' At that time, in 1918, we were in receipt, or our predecessors were, of not less than £20,000 actual net income. Then unfortunately came not only the closing down of all the tin mines and the tin streams, but the China Clay industry became so bad that huge undertakings and splendid organisations with unlimited capital resources, instead of making large profits, as they had done practically from time immemorial, were unable to make any profit at all. So that not only we suffered from loss of income. But there has been as much as possible done by the capitalists who have been good enough to devote themselves to Cornwall to bring into a productive stage things that closed down or suffered under the conditions due to the slump.

" Nobody had the courage to take up new things in the old days ; there seemed to be no incentive or inducement to do so ; but it is quite clear from the various items the chairman has mentioned, that there are new people coming in, but far more slowly than we could wish. Do not, however, let us forget that we have still the 30,000 acres, the possibilities of which are enormous." The resolution was unanimously carried.

In moving the re-election of Messrs. H. Montagu Rogers and F. A. Robinson as directors, Mr. Oliver Wethered referred to the business abilities of these gentlemen and the efficient manner in which they had carried out their duties.—Mr. C. V. Thomas seconded and the election was agreed to. In moving the re-election of Major T. M. Rogers (son of the chairman), as a director, Mr. Thomas said that gentleman had considerable business experience, and his election to the Board would continue to be a distinct advantage to the company.—In seconding, Mr. Robinson assured the meeting that Major Rogers was a very valuable acquisition to the Board. " From what Mr. Wethered has said about the potential value of the property," he added, " there is no doubt we have a valuable undertaking, but we have not had the opportunity of developing it. In the meantime, if we have normal conditions only, there is no reason why the actual amounts we get from the dues and from our China Clay properties should not be sufficient to pay a reasonable return upon the capital of the company. Then in addition to that you have the speculative, or what I might call the potential, value of the vast estates we have acquired."—Major Rogers on being re-elected assured the shareholders that he would do everything he could in the interests of the company.

American Clay Deposits Re-opened

Possible Rival of English China Clay

A MINE of clay, which is reported to equal, if it does not surpass, the best quality English China Clay will be in operation shortly, says the American journal, *Paper*. This mine is at Bennington, Vermont, and will be operated by the Vermont Kaolin Corporation, successors to S. C. Lyons and Brothers. In a crude primitive fashion the mine has been worked for some forty years. More than 50,000 tons have been taken from it and used for enamelling clay, China Clay, manufactured and crude fire clay and for coating paper, but it has never been developed as it apparently warrants development. Such deposits are amazingly rare on the North American Continent. The paper companies which have used the clay in small quantities thus far affirm that the clay is of high quality. The story of the mine is unusual.

When Vermont Clay Industry Began

The paper clay industry in Bennington was established about 1865 by LaFayette Lyons, and was carried on continuously from that time until 1911, first by the above mentioned and later by his administrators, and finally by a partnership of his sons. The process in use was essentially the same as that employed in the South until very recently—viz., flotation through horizontal troughs, sedimentation in open stone-lined vats and in open drying sheds. Obviously, this process could not be carried on during the winter in Vermont, so that it was necessary to discharge most of the employees each fall and then to try to re-engage them when spring came.

After 1909 it became increasingly difficult to handle this help situation, so that several years and a good deal of money were spent in an effort to devise some suitable method of making clay continuously. Before this problem had been completely solved the partnership was dissolved by the death of one of the co-partners. Soon after the Vermont Kaolin Corporation was formed as successors to S. C. Lyons and Brothers.

Working the Mines

In the present development the deposits of kaolin are worked as mines, and at present there is a square, vertical shaft about 65 ft. deep with a horizontal tunnel leading eastward from the bottom. These workings are all solid timbered at the end of each day's work with elm or other cheap, strong timbers. The crude material, consisting of kaolin and intermixed fine silica sand, resembles damp chalk and, requiring no grinding whatever, is hoisted to several feet above ground level and dumped into a hopper from which it is fed by a helical conveyor into a disintegrator (frequently called a " plunger " or " washer ") in which the crude clay is reduced to a homogeneous suspension in water. This washer, in its elements, consists of a horizontal steel shell 15 ft. long and 3 ft. in diameter, borne on two sets of trunnions and rotated by a chain and sprocket device. In addition to the thorough agitation which this device affords, it possesses the advantage of automatically and continuously cleaning itself of coarse sand and other bulky impurities which would tend to clog a vertical washer.

The aqueous suspension or " pulp " thus produced is led into a horizontal trough of sufficient proportions so that the stream of clay, sand and water becomes placid, and the major portion containing clay and fine sand overflows near the top of the trough at the end farthest from its entrance. The coarser sand particles, however, settle to the bottom, and are continuously removed therefrom by a slow moving scraper conveyor travelling along the bottom of the trough. The partially purified material, still in aqueous suspension, is then run through a pipe line to a hydraulic bowl classifier which automatically removes the remaining sand (as fine as 350-mesh if necessary) and discharges the refined, white kaolin and water into a concrete collecting vat 20 ft. by 25 ft. by 5 ft. deep.

A 5 in. pipe-line connects the bottom of this vat with the drying plant, which is half a mile distant, and at a level of 72 ft. lower. By this means the kaolin, while still in the form of a thin aqueous suspension, is floated to the drying plant which is about half a mile nearer the railroad than the mine, and at the same time the expense of hauling coal for drying purposes is correspondingly reduced. Here the sludge from the bottom of one of the two large storage vats is pumped into a recessed plate type of filter press on the second floor. The partly dried cakes as they are discharged from the filter press fall upon a very slow moving apron conveyor which feeds them into a direct-fired rotary dryer, whence, after drying, the product is again elevated to the second floor for ease in packing. Shipment is usually made in 100 lb. paper sacks. Regarding the deposits, the company has sunk shafts in the Shaftesbury deposits to a depth of 115 ft. without penetrating the deposit, and have run a horizontal tunnel a distance of 380 ft. without striking foreign matter. With 20 men working the mine is expected to produce some 6,000 tons of washed clay a year.

The Functions of Paper Fillers

Why English China Clays Are Best

An American papermaking expert, Mr. Elbert G. Milham, of the Bryant Paper Company, Kalamazoo, Michigan, recently gave a paper on "Paper Makers' Fillers" before the annual convention of the American Pulp and Paper Mill Superintendents' Association, in which occur so many valuable hints on what should be the characteristics of a good filler and why our English China Clay is in certain respects superior to American kaolins and other classes of fillers, that we have summarised it for the benefit of our readers.

Mr. Milham pointed out that fillers in book and writing papers have a twofold purpose. The first is to give the sheet certain desirable physical qualities such as opacity, flexibility, body, finish, etc. The second is to lower the cost. While, originally, fillers were looked upon only as adulterants, they are now regarded as necessary constituents in many grades of paper. As a matter of fact, it often happens that purchasers of printing papers actually specify a minimum filler content for certain of their papers.

The Ideal Paper Filler

Of all filling materials available, China Clay has by far the widest range of particle sizes, varying all the way from those which can only be seen with the aid of a powerful microscope up to those which will scarcely pass a 200-mesh screen. From this standpoint English clay is the ideal paper filler. Mr. Milham goes on to enumerate some of what he calls its disadvantages, which, to a certain extent, he says, discount its ideal qualities in other respects. He said the colour of even the best English clay is by no means a bright white, but varies in shade all the way from a light cream to a blue-grey; also it is only fairly free from grit; and its solubility in water is practically zero. It has no appreciable action with alum, it greatly reduces the effectiveness of size, and being a natural product it is hopeless to expect that it will run perfectly uniform. Also the cost is moderate.

Comparison with American Clays

As a class, American clays have an even wider range of particle sizes than the English clays, and in this respect they are of more value than English clays. However, in other respects they are far from the ideal. (1) Their colour is considerably further from a bright white than English clay; (2) as a rule they are grittier than English clays; (3 and 4) they are practically insoluble in water and do not react with alum to any extent; (5) they greatly decrease the effectiveness of rosin size; (6) they are considerably less uniform than English clays; (7) in most localities their cost is somewhat lower than that of English clays. Mr. Milham describes other fillers. Talc, owing to its extremely small range of particle sizes has its utility curtailed as an all-round filler, while its content of fine sharp grit and other impurities, such as carbonate of lime, are constituents that rule it out for general use. Blanc fixe, while similar to talc in its action, is ruled out as a universal filler, and on account of its cost is limited in its use to specialities. Anhydrous sulphate of lime, crystallised sulphate of lime and carbonate of lime have one or two good qualities as fillers, but certain characteristics render them much less effective than China Clay as good paper fillers. The anhydrous sulphate has, like talc and blanc fixe, a low range of particle sizes. The crystallised sulphate is too soluble in water and too expensive for all except the highest grade papers. The carbonate has the serious fault that its use is precluded in all papers in which rosin size and alum are used.

The majority of fillers have a very decided effect upon rosin size. This effect becomes very serious as the proportion of filler increases, and in papers containing over 10 to 12 per cent. ash the problem of hard sizing becomes a truly difficult one. The reason for this lies in the fact that sizing is essentially a surface phenomenon. The sheet does not become thoroughly sized until the surface of every particle of fibre and filler composing the sheet has become coated with the sizing agent.

Fillers' Affinity to Fibre

As regards filler retention by the fibre, the main process of paper-making consists essentially of separating solids from water by means of filtration through a screen varying from 60 to 80 mesh, thus the loss of filler through the meshes of the wire is one of considerable practical importance. The proportion of filler retained in any given type of stock varies considerably with the type of filler used. In considering filler retention in any given stock, the fundamental fact must be kept constantly in mind that it is absolutely out of the question to prevent fillers going through the meshes of the wire if they are not definitely tied up with the fibres. The retention problem is therefore reduced to one of assimilation of filler by the fibre. Beaten fibres are relatively porous, and present an enormous number of crevices for the assimilation of particles of filler if the particles are small enough. This leads to the natural conclusion that obtaining maximum filler retention is largely a matter of particle sizes, such as will fill the available spaces most efficiently. This helps to explain why properly selected clays give higher retention as a rule than the coarser fillers.

English China Clay Recommended

Summing up his conclusions in his references to the use of China Clays as the best all-round fillers, Mr. Milham awards the palm to English China Clays by his verdict that in cases where colour, printing surface, and flexibility are primary considerations, a finely divided English coating clay should be used. In all cases it is well to remember, he added, that filler is ordinarily the cheapest raw material put into paper, and for this reason, if for no other, it does not usually pay to quibble over a few cents difference in cost if the utility of the finished paper is to be reduced thereby.

Our Comments

On the whole, English China Clay producers will appreciate Mr. Milham's impartiality in frankly acknowledging that our products come nearer to being an ideal filler than his own country's clays. In this respect, he confirms the opinion of another American paper-making expert—Mr. Ralph P. Roe, of Boston, a member of the Technical Association of the Pulp and Paper Industry, who a few years ago, in a paper to his association, confessed that American clays were inferior to English clays, mainly on account of grittiness and poor colour. Mr. Milham hardly does justice to "the best English clay" in saying that "even that is by no means a bright white." He must have been unfortunate in the "best" English clays he got hold of, because no one could wish for a brighter white than the majority of the best English clays. In saying "it is only fairly free from grit," he suggests that the grit content is high, whereas it is negligible. As to its uniformity, where so many grades are produced, perfect uniformity of the whole is impossible, but there is very little variation in the comparative uniformity of particular grades. In comparison, Mr. Milham shows that even if in the respects he mentions English clays fall below his exacting requirements of an ideal filler, American clays are much less white, grittier, more varied, and lessen the effectiveness of rosin size still more.

Comparative Cost

As regards the cost, if he substituted "some" for "most" localities, we would agree that domestic clays are lower than English clays, but, quality for quality, it is doubtful whether English clays are more expensive, except when the American deposits are adjacent to the manufacturing works. Other points we would emphasise in favour of English clays are their comparative harmlessness on other paper-making ingredients, and immunity from any deteriorating influence by these ingredients. A point on which our China Clay chemists would probably not agree, is that American clays have a wider range of particle sizes than English clays, but even so, it is the only direction in which it can be claimed they are of more value, Mr. Milham frankly admitting that American clays are in other respects far from the ideal. Other characteristics of English China Clay that Mr. Milham does not mention, are its affinity for printers' ink, and that of imparting density to news print so that the print does not show through. With reference to other fillers recommended for the highest grades of paper and other specialities where cost is not an essential consideration, it should be mentioned that China Clay producers in England cater for these branches of the trade by the production of colloidal clay, a super quality produced by subjecting China Clay to special treatment.

China Clay Notes and News

China Clay Producers and Workers' Union

At a special meeting of the China Clay Employers' Federation on June 25, it was unanimously decided, having regard to the fact that they recognise the Workers' Union and have carried out all previous negotiations with their employees through that Union, that the Workers' Union officials be allowed to address a meeting of the employees on each work in the employers' time in order to facilitate the enrolment of new members by such Union. The Union officials are to apply to each employer to arrange a suitable time for such meeting. This decision is in keeping with the policy adopted since the Workers' Union was recognised, for the purposes of collective bargaining between the Workers' Union, representing the China Clay workers on the one hand, and the Federation, representing the China Clay producers, on the other.

Fowey Harbour Commissioners in Court

Arising out of the dredging operations for the deepening of Fowey Estuary to enable the large China Clay steamers to enter and leave the port at all states of the tide, the Fowey Harbour Commissioners have come into conflict with the Sea Fisheries Committee of the Cornwall County Council. The Commissioners had an arrangement with the Committee to dump the dredged mud from the harbour within the limits of a place known as Lantic Bay, about a mile and a half to the eastward of the harbour mouth. Two men in charge of the hopper barges in the employ of the Commissioners were, on March 25, caught by the Fisheries Officer in the disguise of a fisherman discharging the refuse at points between the harbour mouth and Lantic Bay, where it was alleged it caused injury to sea fish.

The sequel to this adventure was an appearance at Liskeard Petty Sessions Court on July 2 of the two employees, who were charged with discharging into the sea " solid substances detrimental to sea fish." As it was in the nature of a test case counsel were engaged on each side, Mr. A. C. Comyns-Carr, K.C., M.P., appearing for the Sea Fisheries Committee, and Mr. J. Lhind Pratt, barrister, for the employees, whose defence was undertaken by the Commissioners, instructed by Messrs. Graham Wright and Co., of St. Austell. Mr. Walter Graham, the Clerk to the Commissioners, supported Mr. Pratt, and Mr. F. A. H. Shears, deputy Clerk to the County Council, instructed Mr. Comyns-Carr. There was no dispute that some refuse was dumped outside the area, but the defence was that Fowey mud would not reach the bottom of the sea at a depth of 30 to 50 feet in such a condition as to smother the fish and that in other respects the mud contained food on which the fish thrived. The evidence of the Fishery Officer as regards one of the barges that had been towed out by a tug was to the effect that he spoke to Adams, one of the men in charge of the barge, and said, " Is this Lantic Bay " ? Not recognising him as a fishery officer, not being in uniform, Adams replied " No, it lies over that way," pointing in an easterly direction. Mr. Baron then said, " Why are you dumping this refuse here ? " Adams made no answer, but after a considerable pause one of the men on the tug said something about having been for two hours in Lantic Bay. Adams then added, " Oh, yes, we have been there." As a matter of fact, Mr. Baron watched them coming straight out of the harbour to the point where they were discharging, and there were only two places where they could discharge—either in Lantic Bay or outside the three-mile limit. As to whether the dumping of refuse was detrimental to sea fish, counsel said that evidence would be called to prove that crabs, lobsters, and congers were being forced to leave the fishing grounds because of the mud.

A great deal of evidence was called on both sides as to the injurious effect of the mud on the fish and as to its beneficial effect. The two men explained that on the day in question they had been to Lantic Bay with the bulk of the mud and had deposited only small quantities outside the limits. Alfred Joseph Shee, in charge of the tug; Frank Collins, Harbour Master; R. W. Bate, Deputy Harbour-Master; Henry Paull, manager of Fowey Tug Co.; and Sir Arthur Quiller Couch, chairman of the Harbour Commissioners, also gave evidence for the defence.

The magistrates decided on a conviction and fined each man £1, each party to pay their own costs. Mr. Pratt intimated that there might be an appeal. The magistrates fixed the recognisances at £20, Mr. Walter Graham being accepted as surety.

China Clay Producers Stop £16,000 Expenditure

Mainly as a result of the opposition offered by the China Clay producers to the proposed expenditure of £16,000, at the public inquiry held by the Ministry of Health Inspector last August, the Joint Hospital Board of the St. Austell Rural and Urban Districts at their meeting last month decided not to open the tenders that had been invited in accordance with the Ministry of Health's request, as the Board felt that such a huge expenditure was not justified by the needs of such a district as St. Austell. They therefore abandoned this scheme on the understanding that the architect is to prepare a much more modified scheme, the limit of expenditure suggested being £5,000, which will be considered by the Board at their meeting in August. The ratepayers of the St. Austell district are gratified at this result of the timely opposition which was offered by the China Clay producers, but for which the district would have been burdened by this heavy expenditure, not only for the hospital itself, but for the heavy cost of upkeep such a large institution would have involved.

China Clay Trade

Conversation with a member of the China Clay trade suggests that, all things considered, trading conditions are satisfactory. The authority referred to spoke hopefully of the future and was quite convinced that if the exchange difficulty between the different countries in Europe could be relieved, the markets for Cornish China Clays would very rapidly extend.

The product from Cornwall still stands supreme. Inferior domestic clays in other countries of the world are only being used because they are so much less costly owing to the exchange being so much against the export of British productions. Those in the trade are ever awake to the advantage of finding new uses for Cornish clays, and China Clay producers are very much alive to the advantages which would accrue if other fields were discovered for the use of their clays. They are alive, too, to the adoption of all the latest methods for producing clays with the least possible waste residues.

Cornish Kaolin, Ltd.

At the annual general meeting of the Sons of Gwalia, Ltd., on Monday, it was stated that the development work done by Cornish Kaolin, Ltd., during the year had further proved the value of the China Clay deposits upon that company's property, and opened up large quantities for production. The expansion of the China Clay trade since the slump of 1921 had not been so rapid as was hoped for, but there had been steady improvement, and with the Cornish Kaolin Co.'s brands becoming more known there should be a steady increase of sales by that company, ensuring it a profitable and prosperous future.

Tehidy Minerals

According to the profit and loss account of the Tehidy Minerals for the year to December 31 last the income was about £5,000 less than for the preceding period at £34,159, the falling off being principally due to the reduced amount received in respect of China Clay sales, the improvement in the trade noticeable during 1922 not having been fully maintained. However, the undertaking is making steady progress, and the credit balance has been raised to £2,251, or almost double what it was a year previously. (Full report elsewhere.)

Reminiscences

THERE cannot be many whose reminiscences of the China Clay industry are more interesting than that of Captain William Mutton, now residing at Charlestown, and the unfolding of his narrative of those early days will read more like a romance than a real exposition of the crude method of China Clay production. Captain W. Mutton, who is the son of the late Captain Mutton, and was born at Screeda, in the parish of St. Austell, 74 years ago. He has certainly seen the development of the China Clay trade as few could possibly have done. When only 6 years of age Captain Mutton was taken by his father to the clay works, where even at that age his observant eye watched with keen interest men and women working about the China Clay works. One of the things that struck

his imagination very forcibly was the men and women on a platform raised about 20 feet above the pit, working a long wooden lever, pumping the liquid clay through the trunk of a tree in which a hole had been bored through and was being used as a pump. The clay, after being pumped up to the top, was then conveyed to a long wooden launder, thence to an open pan, constructed by sand and earth, where the clay was allowed to rest all the winter. In the following summer the clay would be cut in square lumps and spread around in the open until perfectly air-dried. The clay used to be washed only in the winter, when there was plenty of water, as there were no engines in any of the works in this district seventy years ago, and therefore the water could not be pumped up and used over and over again as is done in the present day. Works which only produced 300 tons a year have now an annual production of 30,000 tons. What has helped to make the industry so productive is, in Captain Mutton's opinion, the development of steam power and the drying kiln. Captain Mutton has four sons, the eldest being employed by Messrs. J. Lovering and Co. as forwarding agent and general superintendent of a section of drying kilns, in succession to his father, who had been with the firm for nearly 40 years. Another son is associated with the cooperage industry, where thousands of casks are manufactured annually for packing China Clay destined to foreign markets. The third son is the manager of the Hensbarrow China Clay Co. and the China Clay Corporation of Devonshire, whilst the fourth is actively engaged as a shipbroker with a large foreign business connection. The subject of this sketch has been a fine leader of men and one conversant with every branch of China Clay production. Some years ago the firm of Messrs. John Lovering and Co. decided to erect a new kiln at Charlestown for drying their Carclaze Clays in order to obviate the heavy costs of road cartage and occasional delays in shipping. Captain Mutton's son got the plans out, and these were approved by the firm, and the work was to be completed as soon as possible under the superintendence of this veteran leader of industry. The work was begun early in the year, and the firm anticipated that the dry might be finished at the expiration of about two years. About 100 labourers and 20 masons were employed on two shifts daily, and 4,000 tons of granite stone were carted to the spot as well as 3,000 tons of sand and 500 tons of cement. The site was covered with trees, which had to be first removed and excavations made a depth of 30 ft., which required frequent blasting operations. A steam engine was installed for hauling and a steam-driven mortar-mill for mixing the mortar which greatly facilitated the work of erection. By Christmas of the same year the work was finished and the fires in the kiln were lit by Mrs. W. T. Lovering, wife of Mr. William T. Lovering, one of the principals of the firm, and Mrs. W. Mutton, wife of Captain Mutton, who had so dexterously executed the work. The new kiln at Charlestown is capable of drying 450 tons per week, and is so ingeniously planned that little or no handling is required when the clay is once dried. A tube is constructed from the docks to the kiln linhay, the wagons are almost automatically filled, the clay is easily conveyed to the ship's hold and consigned more economically than any other dry in the trade. The firm have made many a record at the kiln, which must prove a great advantage in expediting orders to waiting ships.

Captain Mutton, when he first secured work at a clay works, received very small remuneration. Men were only getting 1s. 6d. and women 1s. per day, which continued until after the Franco-German War. It was in 1871 that the first rise took place, it was then 1s. 10d., and continued to increase until it reached 2s. 6d. per day, and it remained at that figure for a period of nearly 30 years. Before the wages reached 2s. many a man and his wife would be pleased if they could get 2s. 4d. a day between them for 8 hours. Captain Mutton is still a striking personality in the very pretty seaport village of Charlestown, and is generally regarded in the highest esteem.

Incorporating Fillers in Paper

According to a note in *Bolletino della Stazione Sperimentale dell'Industria della Carta*, which is translated in *La Papeterie* of April 25, Messrs. Orlando and Moisio have designed and tested out in a Finnish paper mill a new system for incorporating fillers in paper.

Taking kaolin as a typical filler, it is mixed with about four or five times its weight of water in tank I, screened through a 70-mesh sieve at III, and the suspension is collected in a large tank IV, which can hold a twenty-four hours' supply and which is equipped with an agitator to keep the clay in suspension. The rate of flow is regulated at VII, and the two chests VIII and X, in which the suspension is diluted with water, are both provided with a screen at the top.

The clay suspension is delivered on to the wire at the suction boxes by means of the distributor B. It consists of a metal or wooden box extending across the whole width of the sheet of paper and having a slit along one side through which the filler is delivered on to the paper. The width of this slit is adjustable, so as to vary the amount of clay, and the position of B can be changed both vertically and horizontally according to the thickness and weight of the paper, speed of the machine, etc. For if the filler is added too soon a considerable proportion of it may be lost ; while if it is added too late the losses may be considerably diminished, or even suppressed entirely, but then the clay will nearly all remain on one side of the sheet. If the apparatus is carefully adjusted in accordance with manufacturing conditions, the thickness of the paper will be quite even and uniform, and not streaky. The authors claim to have made papers containing anywhere from 2 to 25 per cent. of filler, with a retention of over 90 per cent.

Wembley

As stated in our last issue, The English China Clays, Ltd., propose to take their employees to Wembley on September 5 and 6, at a return fare of 9s. 6d. The original limit of 1,200 tickets has been already absorbed, but the company has since been able to increase the limit to 1,600. Applications for tickets can still be made. The company are having two special trains, which will do the journey through the night of September 5, arriving at Wembley at 8 a.m., returning through Saturday night at 11.30 from Paddington. Each employee is allowed to obtain one ticket for a relative or friend at the return fare of 19s. 6d. Every employee is to be allowed to work up time lost through visiting Wembley. We understand that everyone is looking forward to this visit with great pleasure and we trust that a most enjoyable time will be spent there. Our article on "Wembley and the Paper Industry" will help them to find those places of especial interest.

Plymouth Porcelain

The characteristic faults of Plymouth are firecracks, smoke-staining and wreathing. Firecracks occur most frequently on the white porcelain, though by no means confined thereto, and while they are for the most part at the base of the piece, they may occur anywhere to its great detriment. After a time this difficulty was overcome.

Smoke-staining was due primarily to the wood fuel used, probably also to some defects in the kiln or in the stowage of its contents. The white pieces and those decorated in blue most frequently suffer, again suggesting that these were the earlier pieces made while the manufacture was still quite in its infancy. The teapot figured is one of the instances where the staining is not so pronounced as it is in some specimens.

Wreathing is found on all pieces thrown on the wheel and, always more or less conspicuous; it occurs also on the Bristol ware, but to a much less extent.

Another quite characteristic feature is the use of a peculiar dull-looking blue on many of the early pieces; and in many others decorated with quite a different tone of blue, the colour has run considerably, indicating difficulties in under-glaze decoration. The best of Plymouth porcelain, both paste and glaze, is a beautiful clear white, but a large proportion of it is slightly tinged with yellow.

Printers at Wembley

Printers are well represented by several prominent firms, amongst whom may be mentioned Messrs. Waterlow and Sons, Ltd., with samples of bank notes, stamps and cheques ; Messrs. Blades, East and Blades, Ltd., with an exhibit showing their work as printers and designers of letter-headings, the several stages of colour work are also in process of demonstration ; Messrs. Raphael Tuck and Sons with a magnificent show of post cards, engravings, and general colour work, the whole exhibit being strikingly displayed in a stand of somewhat unique shape and design. Well-known newspapers are to be found housed in small kiosks dotted about the grounds.

Shipping and Export News of the Month

We give below the latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—June, 1924

Arrived.	Name.	Sailed.	Destination.
June 3, S.V.	*Thames*	June 7,	Rochester
June 3, SS.	*Edenside*	June 5,	Gravesend
June 3, S.S.	*Falmouth Castle*	June 6,	Runcorn
June 4, S.S.	*Ebbrix*	June 6,	Antwerp
June 4, S.S.	*T. W. Stewart*	June 6,	Gravesend
June 4, S.S.	*Glenside*	June 6,	Liverpool
June 4, M.V.	*Agathe*	June 7,	Reval
June 4, S.S.	*Glenrose*	June 5,	Sunderland
June 4, S.S.	*Andalusia*	June 6,	Antwerp
June 4, S.S.	*Dunvegan*	June 6,	Preston
June 4, M.V.	*Zeebar*	June 11,	Hamburg
June 5, S.S.	*Mellanear*	June 11,	Rotterdam
June 5, S.S.	*Orleigh*	June 6,	Rotterdam
June 5, S.S.	*Tron*	June 12,	Antwerp
June 6, M.V.	*Shamrock*	June 7,	Plymouth
June 6, S.V.	*Waterwitch*	June 14,	Preston
June 8, S.S.	*Solve*	June 12,	Bo'ness
June 8, S.S.	*Ualan*	June 13,	Brussels
June 8, S.S.	*Damptre*	June 12,	Botwood
June 9, S.S.	*Vikfred*	June 12,	Gothenburg
June 9, S.S.	*Inga*	June 12,	Helsingborg
June 9, S.S.	*Arethusa*	June 13,	Bordeaux
June 11, S.S.	*Shoreham*	June 14,	Weston Point
June 12, M.V.	*Arjuma*	June 17,	Reval
June 12, S.S.	*Claretta*	June 16,	Preston
June 12, S.V.	*Mary Ann*	June 21,	Weston Point
June 12, S.S.	*Mistley*	June 18,	Methil
June 14, S.S.	*Vilvorde Maritime*	June 17,	Brussels
June 14, S.S.	*Edith*	June 18,	Fredrikshald
June 14, S.V.	*Gauntlet*	June 20,	Weston Point
June 16, M.V.	*Zeehond*	June 20,	Sandviken
June 16, S.S.	*Ferndene*	June 19,	Santander
June 17, S.S.	*Bangor*	June 19,	Fleetwood
June 17, S.S.	*Falmouth Castle*	June 19,	Runcorn
June 18, S.S.	*Ravenspoint*	June 20,	Genoa
June 19, S.S.	*Ebbrix*	June 20,	Antwerp
June 20, S.S.	*Jessie Summerfield*	June 21,	Preston
June 20, S.V.	*Venturer*	June 25,	Gravelines
June 20, S.S.	*Alberta*	June 21,	Gravesend
June 20, S.S.	*Fredensborg*	June 25,	Portland Main
June 20, S.S.	*Singapore Maru*	June 30,	Portland Main
June 20, M.V.	*Cimbria*	June 24,	Odense
June 20, S.V.	*Annie Jones*	July 4,	Gravelines
June 22, S.S.	*Torfrey*	June 25,	Pasages
June 23, S.S.	*Norway Maru*	July 6,	Boston, U.S.A.
June 23, M.V.	*Marie*	June 30,	Par
June 24, S.S.	*Luise Hemsoth*	July 2,	San Francisco via Glasgow
June 25, S.S.	*Hampshire Coast*	June 27,	Liverpool
June 25, S.S.	*Wales Maru*	*	New York and Philadelphia
June 25, S.S.	*Ortona*	June 26,	Newlyn
June 26, S.V.	*Englishman*	July 8,	Weston Point
June 26, S.S.	*Bruxelles Maritime*	July 1,	Brussels
June 26, M.V.	*Maria*	June 30,	Bo'ness
June 27, S.S.	*Dunvegan*	July 1,	Runcorn
June 28, S.S.	*Gertie*	July 2,	Fleetwood
June 28, S.V.	*Alert*	July 8,	Runcorn

* Signifies in port.

Charlestown Shipping—June, 1924

Arrivals

Date.	Vessel.	From.
June 1	*Mary Barrow*	Cardiff
June 2	*Gauntlet*	Runcorn
June 2	*C. & F. Nurse*	Falmouth
June 4	*Katherine*	Penryn
June 5	*Waterwitch*	Falmouth
June 5	*Adelaide*	Newport
June 14	*Naiad*	Cardiff
June 14	*Regina*	Torquay
June 15	*Halton*	Plymouth
June 21	*Isabella*	Falmouth
June 22	*Charbomire*	Brussels

Sailings

Date.	Vessel.	Destination.
June 3	*C. & F. Nurse*	London
June 4	*Katherine*	Manchester
June 6	*Waterwitch*	Preston
June 6	*Madeleine*	Nantes
June 14	*Gauntlet*	Western Point
June 15	*Halton*	London
June 20	*Regina*	St. Malo
June 20	*Lord Haig*	Maidstone
June 20	*Mary Barrow*	Kirkcaldy
June 23	*Charbomire*	Brussels
June 24	*Isabella*	Runcorn
June 30	*Naiad*	Antwerp
June 30	*Adelaide*	London

Par Harbour Shipping—June, 1924

Arrivals

Date.	Vessel.	From
June 1, M.V.	*Katie*	Rochester
June 2, S.S.	*Isabella*	St. Bruix
June 3, S.V.	*Flying Foam*	Runcorn
June 3, S.V.	*Dispatch*	Brest
June 3, S.S.	*Pet*	Mevagissey
June 4, S.S.	*Edith*	Teignmouth
June 4, S.S.	*Millocrat*	Truro
June 4, S.V.	*Mary Edwards*	Port Houstock
June 4, S.S.	*Balmyle*	Kilrush
June 7, S.S.	*Katherine*	Plymouth
June 7, S.V.	*R. Passmore*	Port Houstock
June 7, S.V.	*Alice Williams*	Falmouth
June 13, M.S.	*Lutona*	Cowes
June 14, M.V.	*Hanna*	Southampton
June 15, S.S.	*Lilly*	Karlstad
June 15, M.V.	*Isabel*	Avonmouth
June 15, S.S.	*Coniscrag*	Cardiff
June 16, S.V.	*Snowflake*	Runcorn
June 17, S.V.	*Henrietta*	Poole
June 17, M.V.	*Regina*	Plymouth
June 20, S.V.	*Hosianna*	Falmouth
June 22, S.V.	*Challenge*	Torquay
June 24, S.V	*Western Lass*	Charlestown
June 24, S.S.	*Balmyle*	Plymouth
June 26, S.S.	*Goliath*	Fowey
June 26, S.S.	*Tanny*	Avonmouth
June 27, S.V.	*Glenway*	Plymouth
June 27, M.V.	*Regina*	Plymouth
June 28, S.S.	*Magrix*	Teignmouth
June 28, S.V.	*Rose*	Port Houstock

Sailings

Date.	Vessel.	Destination.
June 2, M.V.	*Diolinda*	Garston
June 5, S.V.	*Hero*	Western Point
June 5, S.S.	*Isabella*	Ghent
June 5, S.S.	*Edith*	Fleetwood
June 5, S.S.	*Millocrat*	Preston
June 6, S.V.	*Dispatch*	Gloucester
June 6, S.S.	*Balmyle*	Western Point
June 12, S.S.	*Katherine*	Plymouth
June 12, S.V.	*Mary Edwards*	Port Houstock
June 16, S.V.	*Katie*	Rochester
June 16, S.V.	*Flying Foam*	Western Point
June 16, S.V.	*R. Passmore*	Western Point
June 16, S.V.	*Alice Williams*	London
June 17, M.S.	*Lutona*	Antwerp
June 19, S.V.	*Snowflake*	Runcorn
June 20, M.V.	*Isabel*	Port Houstock
June 20, M.V.	*Hanna*	Poole
June 20, S.S.	*Lilly*	Drummen
June 20, M.V.	*Isabel* (2)	Bristol
June 20, S.V.	*Henrietta*	Runcorn
June 20, M.V.	*Regina*	Pentewan
June 26, S.V.	*Challenge*	Queenborough
June 27, S.S.	*Goliath*	Fowey
June 28, S.S.	*Tanny*	Penarth
June 28, M.V.	*Regina*	Pentewan
June 29, S.V.	*Hosianna*	Runcorn
June 29, S.S.	*Balmyle*	Runcorn
June 29, S.V.	*Snowflake*	Runcorn
June 30, S.S.	*Magrix*	Teignmouth

Par Harbour Tide Table, July, 1924

(British Summer Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Tuesday	1	5.47	6.8	11.10
Wednesday	2	6.27	6.47	11.9
Thursday	3	7.6	7.24	11.8
Friday	4	7.41	7.58	11.7
Saturday	5	8.15	8.33	11.4
SUNDAY	6	8.50	9.8	11.4
Monday	7	9.27	9.47	11.3
Tuesday	8	10.6	10.28	11.1
Wednesday	9	10.53	11.17	10.11
Thursday	10	11.45	—	10.8
Friday	11	0.12	0.44	10.8
Saturday	12	1.19	1.50	10.11
SUNDAY	13	2.30	3.5	11.6
Monday	14	3.38	4.13	12.3
Tuesday	15	4.45	5.16	12.11
Wednesday	16	5.45	6.12	13.6
Thursday	17	6.39	7.6	13.2
Friday	18	7.31	7.54	13.1
Saturday	19	8.16	8.37	12.8
SUNDAY	20	8.58	9.20	12.4
Monday	21	9.40	10.1	11.10
Tuesday	22	10.21	10.41	11.4
Wednesday	23	11.2	11.25	10.9
Thursday	24	11.50	—	10.2
Friday	25	0.16	0.47	9.9
Saturday	26	1.21	1.56	9.9
SUNDAY	27	2.31	3.05	10.0
Monday	28	3.38	4.9	10.6
Tuesday	29	4.37	5.2	11.1
Wednesday	30	5.25	5.47	11.5
Thursday	31	6.9	6.28	11.8

E. CLEMENS, Harbour Master.

China Clay Exports

RETURN showing the exports of China Clay, the produce or manufacture of the United Kingdom, from the United Kingdom to each country of destination, registered during the month ended June 30, 1924 :—

Country of Destination.	Quantity. Tons.	Value. £
Russia	303	698
Finland	514	723
Esthonia	1,134	1,806
Latvia	51	108
Sweden	1,547	4,586
Norway	735	2,111
Denmark	—	3
Germany	1,934	5,473
Netherlands	2,898	6,978
Belgium	3,903	7,599
France	3,620	8,358
Switzerland	47	128
Spain	1,974	3,324
Italy	1,921	4,507
Egypt	12	51
China	27	107
United States of America	23,266	56,304
Argentine Republic	105	414
Irish Free State	1	2
Natal	2	22
Bombay *via* other Ports	805	3,077
Bengal	205	820
Hong Kong	—	1
Western Australia	10	40
Victoria	10	41
Queensland	—	3
Canada	103	137
Newfoundland	2,802	5,157
Total	47,929	112,578

June China Clay Deliveries

As predicted last month there was a considerable falling-off in the volume of deliveries of China Clay in June, the lessened shipments from Fowey almost wholly accounting for the drop of over 24,000 tons on the month. The total shipped through Fowey was 46,705 compared with 69,544 tons in May. The falling off of shipments is due to the lessened demand from America, the dislocation of business through the Presidential elections always having a depressing effect on the China Clay trade while the campaign is going on. The same factor will influence the total for the present month, very few big cargoes having been cleared up to the middle of the present month.

Details of deliveries :—

Port.	Tons.
Fowey (including 2,930 tons china stone)	49,781
Par (including 360 tons china stone)	5,630
Charlestown	3,374
Plymouth	496
Newham	176
By rail direct to destinations	3,880
Total	60,261

compared with 84,370 tons for May.

In addition to the above China Clay deliveries, 3,076 tons of ball clay were shipped through Fowey and 297 tons through Plymouth. The position of the trade for the six months compared with other years is dealt with in a special article elsewhere.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act, of 1908, provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

TORQUAY POTTERY CO., LTD. Registered June 21, £2,000 (not ex.) mortgage to Lloyds Bank, Ltd.; charged on properties at Hele Cross, Torquay and Bovey Tracey. *Nil. March 29, 1924.

UNITED CHINA CLAY CO., LTD., London, E.C. Registered June 4, £17,500 debentures; general charge. *£8,500 bank, £2,500 mortgage. May 8, 1923.

Satisfactions

NORTH STAFFORDSHIRE BRICK AND TILE CO., LTD., Chesterton. Satisfaction registered June 21, £8,500 registered April 3, 1905.

ORRELL BRICK AND TILE CO., LTD. Satisfaction registered June 25, £200, part of amounts registered April 16 and May 22, 1919.

UNITED CHINA CLAY CO., LTD., London, E.C. Satisfactions registered June 13, £8,500, registered November 24, 1917; and £2,500, registered January 15, 1918.

London Gazette

Companies Winding Up Voluntarily

CARRON GROVE PAPER CO., LTD. G. H. Bond, Bush House, Aldwych, London, chartered accountant, appointed liquidator. A. A. Gardner, Chairman.

FOURSTONES PAPER MILL CO., LTD. J. E. Wilson, 24, Basinghall Street, London, chartered accountant, appointed liquidator. NOTE.—All creditors and shareholders will be paid in full, the winding-up being in consequence of the company having sold its business.

GUTHRIE, CRAIG, PETER AND COMPANY, LTD. T. M. Guthrie, solicitor, Brechin, appointed liquidator.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., 8, Bouverie Street, London, E.C.4. All communications relating to Advertisements, Subscriptions and other business should be sent to the Manager, "The China Clay Trade Review," at the same address. Telegrams—"Allangas, Fleet, London." Telephone—City 9852 (6 lines).

Contents

	PAGE
EDITORIAL NOTES	7
Ultra-Purification of Petroleum with China Clay	8
Hard Porcelain: By K. H. Reichau, D.Ph.	9
Pottery and Porcelain	15
Bentonite Deposits in Western Canada	16
Notes and News	17
The Overshot Water-Wheel	18
Commercial Intelligence	19
Shipping and Export News	20

What the China Clay Industry Needs

WE are too much interested in the prosperity of the China Clay industry to wish to offer any but helpful criticism of the methods adopted for extending its existing markets and developing new ones. Therefore, when we emphasise its lack of the "publicity sense" as one of the reasons why there is not more rapid expansion of the industry and more successful resistance to the encroachments of foreign competition in export markets, we merely reiterate what has often been said before by ourselves, and others less interested in its welfare.

When we write of the "publicity sense," we have in mind, not merely the cultivation and use of publicity on the part of individual firms engaged in the industry, but of what we may describe as "community publicity" by the industry as a whole. The China Clay industry is peculiarly well adapted for "community publicity," because it is an industry carried on in a comparatively compact area, and is organised in certain respects by an Association whose operations are concerned with the development of the interests of the industry as a whole. By means of propaganda in pushing China Clay as a standard article of commerce, as distinct from different brands of it, the industry might, through its Association, make more use than it has yet done of publicity generally, without detriment to publicity by individual firms, who with advantage might themselves go in for more individual advertising.

There are many directions in which the industry through its Association might undertake direct propaganda in the trade and commercial press, but we can only touch on one or two of them here. It might emphasise the importance to users of being able to rely upon the different classes of China Clay that are officially graded by the Association. It might give an impetus to new business by the issue of official announcements setting forth the many uses of China Clay and the manner of its use, on some such lines as this journal has for some time gratuitously published in the interests of the industry, and which, we have had evidence to show, has led to the opening up of more markets for the product. A direction in which the industry could counteract the competition of foreign clays lies in emphasising the superiority and reliability of English China Clays, and making the most of such foreign testimony to their merits as that from an American paper-clay expert we published last month.

By adopting aggressive propaganda on the lines suggested and others that will occur to the "publicity" mind, the industry might stave off the encroachments of outside competition, and increase the volume of China Clay business, which would not only be beneficial to the industry as a whole, but also to individual firms. With the settlement of the European political problem in sight, with the stimulating influence it will have upon Continental trade development, the time would appear to be opportune for keen propaganda work for the purpose of hammering home the unrivalled position occupied by English China Clays as regards quality, uniformity and reliability, and why manufacturers should prefer them to all others.

The Past Half Year

UNTIL the *China Clay Trade Review* took steps to secure and publish, month by month, the dissected figures relating to the overseas business in china clay, the industry had no means of knowing what the trend of trade was with individual countries, the monthly totals published by the Board of Trade in their trade returns giving no clue to this information. Consequently the industry had to wait until the figures were published with the details in the annual returns to satisfy their desire for information as to whether trade with particular countries showed an increase or decrease compared with previous years. With the figures published every month in this Review an up-to-date index to the trend of the trade is provided that enables producers and merchants to see how their trade is standing in relation to individual countries at the present time, and to what extent certain known causes for the increase or decrease, as the case may be, are operating to the benefit or disadvantage of the industry. Hence these figures are amongst the most sought-after information that the Review publishes month by month, in conjunction with the monthly returns of total deliveries.

In the tables following we have aggregated the figures for the first six months of this year, placing alongside them the figures for the corresponding period last year. Some interesting facts emerge from an analysis of these statistics. In the first place, it will be noted that the total trade for the six months was some 4,000 tons below the corresponding six months. The falling off in the home trade was marked by a reduction of over 48,000 tons, while the exports showed the welcome increase of over 44,000 tons, all but 10,000 tons of them being accounted for in excess deliveries to the United States. There was a falling off of 6,000 tons to the Scandinavian countries, including Finland, Esthonia and Latvia. The European countries that revealed the most marked increases were the Netherlands, with nearly 6,000 tons, Germany and Spain each approaching 3,000 ton increases, while Canada, whose figures are lumped with those of Newfoundland, showed an even greater increase.

Hopeful European Situation

Significant of the lack of trade progress in Belgium and France is the almost stationary position of the figures for these two countries, accounted for by the depressed exchanges, which in turn have been affected by the long drawn-out crisis over reparations. Now that this international trade disturber bids fair to be settled on a definite

basis, a great impetus to the china clay trade should follow. Of all china clay customers, Italy and Spain are the only ones that have approached their pre-War volume of imports of china clay. Taking a year's average, Russia is over 40,000 tons in arrears, Germany 80,000, Netherlands 33,000, Belgium 3,000 and France 5,000. On the other hand, the United States of America has greatly increased its pre-War yearly average of 250,000.

The falling off in the home markets is due to a variety of causes, two of the chief being the lessened demand from the cotton mills of Lancashire and the potteries of Staffordshire, while the fact that some industries in which the commoner grades of china clay were formerly used are now using a cheaper substitute is also a contributory factor. The demands from the paper mills are on the increase, probably due to the fact that home paper makers are paying more attention to the utility and economy of china clay in coated papers, as their confrères in the States have long since done. The statistics also show a further decline in the average price of china clay, which is now only £1 per ton above the average pre-War price, and something like 16s. per ton below the "boom" post-War year of 1920. A reliable officially graded china clay is now obtainable at as low a price as 25s. per ton f.o.b.

In comparing prices with those ruling before the War it must always be borne in mined that present-day establishment charges are very much higher on a greatly lessened volume of trade; if and when the industry recovers its pre-War volume in European markets and is able to spread its establishment charges over a volume of trade more nearly approaching its productive capacity further substantial price reductions will be possible.

First Six Months' Statistics

	1923.		1924.	
Foreign—	Quantity. Tons.	Value. £	Quantity. Tons.	Value. £
Russia (Esthonia and Latvia)	—	—	1,743	3,566
Finland	4,048	7,875	2,609	4,794
Sweden	8,302	20,345	6,707	16,655
Norway	9,767	15,853	5,009	9,420
Denmark	1,322	3,620	1,737	4,907
Germany	4,391	12,676	7,068	18,905
Netherlands	11,862	29,958	17,304	42,674
Belgium	27,858	57,832	28,236	58,664
France	19,623	42,454	19,770	42,965
Switzerland	456	1,078	341	861
Portugal	52	258	5	21
Spain	6,601	20,174	9,268	25,965
Italy	11,913	29,901	12,071	33,061
Japan	111	628	2	7
Austria	98	320	47	150
Hungary	474	1,560	—	—
U.S.A.	149,680	361,431	184,085	440,529
Mexico	356	1,566	463	2,056
Argentine	313	1,300	426	1,969
Other foreign countries	150	644	1,060	4,624
Total foreign countries	257,377	609,473	297,951	711,793
British—				
India	10,246	39,728	9,941	39,240
Australia	148	1,058	217	981
Canada (including Newfoundland)	623	2,220	3,778	7,398
Other British possessions	38	125	1,010	2,098
Total British possessions	11,055	43,131	14,946	49,717
Total foreign countries and British possessions	268,432	652,604	312,897	761,510
Total home markets	163,814	397,934	115,231	253,508
Total home and overseas	432,246	1,050,538	428,128	1,015,018
Average price per ton	£2 8s. 7d.		£2 4s. 0d.	

Ultra-Purification of Petroleum with China Clay

ALL those who are practically acquainted with the work of refining know that lamp oils (and especially heavy oils), even after complete refining and filtration, although perfectly limpid, produce after some time a deposit consisting of gummy, tacky, and mucilaginous substances, which some writers ascribe to oxidation. Very often these substances are products of refining in an extremely divided state, which causes them to escape in filtration; but they also comprise those well-known naphthene soaps which possess the property of forming, with their water of solution and petroleum, perfectly homogeneous mixtures, identical with those from alcoholic solutions of oil, owing to intermediary substances, like cyclohexanol phenols, ethyl-ether.

These naphthene and sulpho-naphthene soaps formed, in washing the oils with soda lye, introduce mineral matter which is detrimental to the quality of lamp oils and also that of lubricating oil, in cases where the lubricant is brought into contact with traces of humidity, for example, which destroy the state of equilibrium of the solution of extraneous matter in the oil, producing consistent gummy solutions. Finally, the oil may contain non-saturated, oxidised, resinified compounds in a clear solution after refining. These are quickly polymerised under the effects of lime and light, especially when glass vessels are employed, as in lamps.

Long years of practical experience enabled Mr. A. Guiselin to observe that this detrimental change in an oil after being kept for some time can be prevented by a final purification of the refined oil with China Clay, the absorbing properties of which very fortunately extend to these complex, unstable substances, this final treatment being followed by a filtration on cotton wool. The following is the description of a device for this ultra-purification of oils. A number of osier screens or wine gauze in frames are fixed on angle irons riveted to the sides or simply wooden wedges, in a tank with a conical base and a very large square or circular section for filtering surface. These superposed trays form different compartments. Coarse cloths, sacking, or old press-filter cloths are laid on them and then working upwards from the base, a layer of coarse sea salt on the first tray, one of cotton wool on the second and finally a layer of coarse river sand between the two last. There is a pipe at the base of the tank for entrance of the petroleum and an overflow pipe at the top. When the oil has been washed with water and is suitably deposited it is run into a special agitator to be shaken up with 1 to 2 per cent. of very fine dry China Clay, which completes bleaching and absorbs the extraneous matter previously described, some of which remains in suspension with the fine particles of clay. The oil is run from this agitator into the filter either by gravity or by means of a pump. Under the action of pressure the oil ascends through the salt and is finally dehydrated. At the same time it liberates the liquid matter in suspension, which falls to the conical base, from which it can be removed after each filtration. Passing through the cotton wool the oil gives off the semi-liquid fine particles which escape the salt filter. As for the gravel, it will act as a final filter and give a uniform action to the two lower filters over all their surface. With a moderate delivery from such a filter the results are sure to be excellent, lamp oils being freed from all matter usually forming deposits. This filter can also be used for ultra-refining of lubricating oils.

The filter must be inspected from time to time and the cotton wool changed when the delivery of the filter decreases under a constant pressure of liquid. It will then be seen that the cotton wool contains a large quantity of mucilaginous and gummy matter which would escape ordinary filtration.—*Metières Grasses*, April, 1924.

Exports to Irish Free State

ACCORDING to the official reports of the Dublin Chamber of Commerce, during the month ending May 31 the exports of China Clay from Great Britain to the Irish Free State amounted to 35 tons, valued at £195. The uses of China Clay in Ireland include paper-making, bleaching, pottery-making, and oil-refining.

Contribution to the Better Knowledge of Genuine Hard Porcelain*

By K. H. Reichau, D.Ph.

The following article is a translation from the German, and is published by permission from the Transactions of the Ceramic Society, 1923–1924, and will be of interest to our friends in the Potteries, as well as to the China Clay industry.

Of recent years several references have been made by competent writers[1] to the numerous possibilities of applying the mineralogical miscroscope to practical uses. Nevertheless, this instrument has hitherto gained admittance into the laboratories of large industrial concerns only in isolated instances and with greater difficulty than, for example, the metallographical microscope. Yet it is reasonable to assume that, in the near future, the mineralogical microscope will be assured of a leading position in the silicate industry, particularly in the fine ceramic, and, above all, in the porcelain branch, just as the metallographical microscope has, to-day, become an indispensable adjunct to the metal industry as a whole.

The microscope has already been applied repeatedly to the investigation of silicate bodies and of porcelains. In recent times its aid in the examination of clays and porcelains has been invoked by Hussak[2], Vernadsky[3], Glasenapp[4], Penske[5] and Zöllner[6] in particular. In comparison with the results obtained by purely chemical means, the data deduced by the aid of the microscope were relegated to a position of such subsidiary importance, that Steger[7] could write: "Only in exceptional cases are ceramic products subjected to thorough mineral-optical tests." However, when Rieke and Gary[8], at the request of the German Society for Testing Technical Materials, developed, for the first time, a satisfactory method of testing porcelain, they came to the conclusion, after comparing the results of such tests on commercial porcelains with data obtained by examining the same products in thin section under the mineralogical microscope, that it might even be possible after a further development of the mineral-optical method of testing, to obtain full information as to the quality and properties of a porcelain merely by a careful examination of the material in thin section.

It may be of interest, therefore, to review the methods and results of mineral-optical tests on technical porcelains, using a microscope specially constructed for this purpose by the firms of Zeiss, in Jena, and Winkel in Göttingen; and also to determine whether, and to what extent, such results could be attained by any method other than the purely optical one. In addition to a few porcelains, which were fired specially for the purpose, the electro-technical porcelains, including those employed in the manufacture of Hewlett insulators, were considered particularly suitable, for various reasons, for these investigations. This latter type of insulator, which is extensively used, is technically by no means easy to make, since it consists of sections composed both of thick and thin porcelain bodies. Furthermore, the German Electro-Technical Society has issued special detailed instructions, based on a wide practical experience, for testing the Hewlett type of insulator[9]. These recommendations, if properly interpreted as a whole, go to the very heart of what is exclusively a fine-ceramic problem. They prescribe not only that the finished insulator shall have a satisfactory external appearance, but that there must also be a perfect union of body and glaze; and further, that the body must be thoroughly dense, that the finished article must be sufficiently strong, both mechanically and electrically, and must be resistant to sudden (though restricted) changes of temperature. In the last-named test, which is known as the "heat-test," the finished piece is immersed alternately, three times, in cold (15° C.) and warm (75° C.) water, and is allowed to remain in the water sufficiently long to ensure that the whole body is warmed through, or cooled down. This "heat test," in conjunction with the demand for an absolutely non-porous body, represents the "experimentum crucis" for the value of a high-tension insulator. The more resistant a porcelain to this combined test, the better will it automatically satisfy the mechanical and electrical strength-test.

Several commercial Hewlett suspension insulators of 220 mm. diameter, supplied by two different works *A* and *B*, successfully withstood the piece-tests. Tests on the two materials indicated that the mechanical breaking stress for quality *A* was, on the average, 9 per cent. higher than for quality *B*, and that, under identical conditions, the electrical break-down strength in oil, at 100 cycles per second, was greater by 12 per cent. on an average, in the case of *A* as compared with *B*. In the "heat-test," quality *A* withstood permanently a temperature change of 90° C. (alternate immersion in boiling water and water at 10° C.), whilst quality *B* collapsed repeatedly on the first treatment at a temperature range of 45° (from water at 60° to water at 15°). On breaking with the hammer, material *A* proved to be tough and showed a conchoidal fracture, while *B* was brittle and broke like glass. A solution of fuchsin in alcohol showed no tendency whatever to "run" on the fractured surface of *A*; a thick stroke drawn across the surface with a pen exhibited, when dry, a clearly-defined outline. On the fractured surface of *B*, on the other hand, the fuchsin "ran" as on sandstone, without, however, penetrating into the body of the material to any visible extent. After the heat-test, the glaze on material *B* tender to craze, especially in the small grooves, in which a thicker layer of glaze had collected in the glost oven, the crazing being only visible on being magnified fifteen times. The glaze on body *A* remained quite intact, even after repeated heat-tests.

The chemical analyses gave:—

Mat.	Loss on ignition	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O K_2O	Total.	Melting point.
A	0·10	71·40	27·58	0·75	0·35	0·06	2·22	102·46	1690° C.
B	0·22	75·64	22·63	0·68	0·63	0·06	2·61	102·47	1670° C.

These analyses justify the conclusion, in explanation of the results of the above tests, that material *B* is richer in fusible quartz-felspar ingredients than *A*, owing to its higher alkali, and lower alumina content. Accordingly it should, as actually found by experiment, melt at a lower temperature than material *A*. This excess of fusible ingredients in *B* as compared with *A*, would also explain its great sensitiveness to sudden changes in temperature. On the other hand, contrary to the result of the fuchsin solution test, the fractured surface of material *B* ought to have appeared more dense than that of *A*. The result of the glaze test warranted the conclusion, that the glaze on material *B* was less suitable to the body, as regards its maturing temperature, than in the case of material *A*, although both glazes were adjusted sufficiently well to their respective bodies in respect of their coefficients of expansion.

The real explanation of the extraordinary superiority of material *A* over material *B* is, therefore, not forthcoming from the results of these physical and chemical tests. Similarly, neither by physical tests nor chemical analysis is it possible to discover the reason why one high-speed steel is better than another. Yet, just as in the case of a steel, the metallographical microscope discloses the internal structure—and hence the reason for its superiority or otherwise—so the mineralogical

* The author takes this opportunity of expressing his sincere thanks to Dr. Köhler, of the Zeiss Works, Jena, to whose skill he is indebted for the photographs accompanying this paper; and to the representatives of the Firm in Berlin, particularly to Messrs. Otto and Kahle, for their interest and assistance in the work.

[1] F. Rinne, *Kristallographische Formenlehre*, 4th and 5th Edition, Leipzig, 1922; E. Weinschenk, *Das Polarisationsmikroskop*, 4th Edition, Freiburg, 1919.
[2] *Sprech.*, **12**, 153, 1889.
[3] *Bull. Soc. franc. Min.*, **13**, 256, 1890.
[4] *Tonind. Ztg.*, **31**, 1167, 1907.
[5] *Ueber Mikrostruktur und Bildung der Porzellane*. Dissertation, Aachen, 1907.
[6] *Zur Frage der chem. u. phys. Natur des Porzellans*. Verlag Freistudent Schriften. Charlottenburg, 1908.
[7] Singer, *Die Keramik*, Braunschweig, 1923, p. 468.
[8] *Ber. D. K. Ges.*, **3**, 5, 1922.
[9] *Elektrotechn. Zeitschrift*, **43**, 26 and 1347, 1922.

microscope will, in the same manner, provide the explanation in the case of porcelains and glasses.

Figs. 1 and 2 are photographs of the fractured surfaces of materaials *A* and *B*, magnified 20 times and with vertical illumination. Both pieces were treated in exactly the same way. Immediately after breaking the piece, an ink mark,

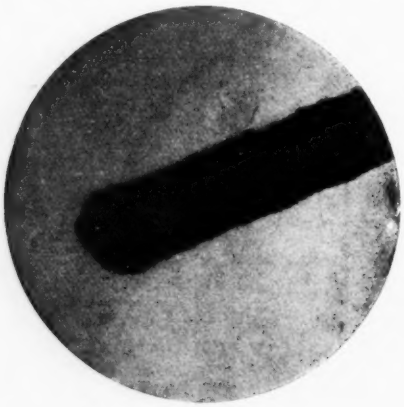


FIG. 1.
PORCELAIN *A*.
SHOWING INK MARK ON FRACTURED SURFACE, VERTICAL ILLUMINATION. (×20).

about 0·7 mm. thick, was made on the fractured surface, by means of a blunt pen. Sufficient ink was applied in both cases to allow for the possibility of the ink "running" on the surface, or of being absorbed by the body. Both pieces, *A* and *B*, were then left until the ink was thoroughly dry. The illustrations show the outlines of the ink marks on the fractured surfaces. It can easily be seen that the ink has "run" at the edges on both bodies (though to a much greater extent on body *B* than on body *A*), thus giving the impression that both bodies were porous in the ceramic sense. Nevertheless, independent tests for real and apparent porosity, carried out on the same bodies by other experimenters according to the methods described by Kallauner, Barta and Simane[10], showed con-

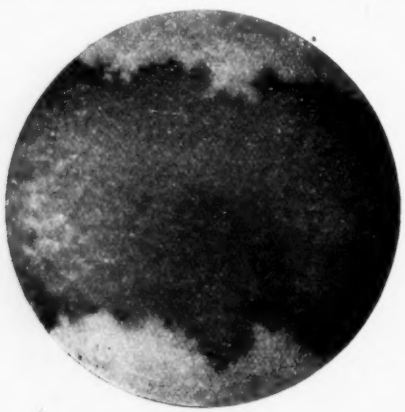


FIG 2.
PORCELAIN *B*.
SHOWING INK MARK ON FRACTURED SURFACE. VERTICAL ILLUMINATION. (×20).

clusively that neither body *A* nor body *B* was porous to any measureable degree.

Figs. 3 and 4 are photographic reproductions of materials *A* and *B* in thin sections, with magnification 250, taken in natural yellow light (layer 5 cm. thick, of saturated potassium bichromate solution) on an ortho-chromatic plate, with an 8-mm. Zeiss apo-chromatic lens, numerical aperture 0·65 and

[10] *Sprech.*, **55**, 45, 1922.

inclined at an angle of 45° to the vibration plane of the polariser. "Homal I."[11] These illustrations show very remarkable differences in the internal structure of the materials. Fig. 3 shows only a few clear glassy areas on a background of a felted, crystalline material. These glassy areas, the edges of which are not easily discriminated, also enclose crystals which extend

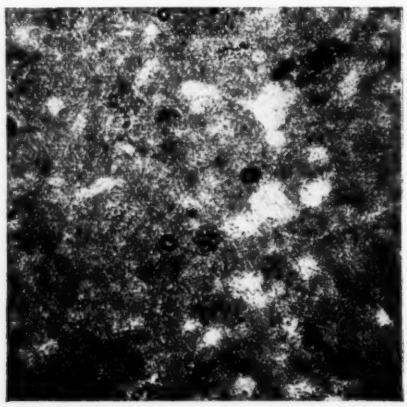


FIG. 3.
PORCELAIN *A*.

from the boundaries towards the centre. Body *B* (Fig. 4) exhibits no such tendency to the formation of a homogeneous, crystalline groundmass of this nature; on the contrary, it contains a large number of angular rock fragments, which are grouped together in an incoherent mannner and among which the sharp outlines of many individual grains of raw material as used in making up the body are plainly visible. These separate grains are by no means of the same material, as microscopic determination of the refractive index by the Becke method[12] clearly shows.

Figs. 5 and 6 are photographic reproductions of the two bodies in thin section, magnified 30 times, and taken in filtered, circularly polarised light according to Dr. Köhler's method, which is described as follows: "A quarter-wave mica plate was inserted above the Nicol prism serving as a polariser; this

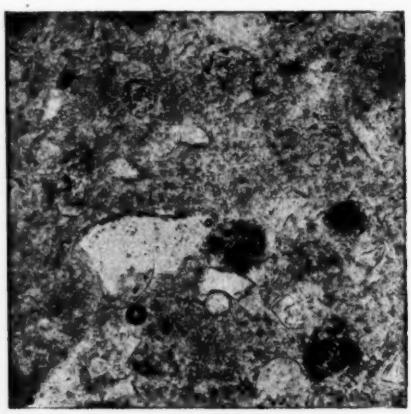


FIG. 4.
PORCELAIN *B*.
THIN SECTIONS IN NATURAL, YELLOW LIGHT (×250).

mica plate was so fixed that the axis of the index ellipsoid was A similar plate was placed at 90° to this frame above the objective. By this arrangement, practically all the undissolved quartz grains in the body appeared more or less clear against a

[11] A combination of lenses, placed near the eye-piece, to counteract errors due to aberration, dispersion, etc., and to give a flatter field.

[12] F. Rinne, *Einführung in die kristallographische Formenlehre*, Leipzig, 1922, p. 113, *et seq.*

dark background, unless they happened to be vertical to the axis or had caused a phase difference equal to one wave-length which was highly improbable in a section of this thickness."[13]

The tremendous difference in the quantity of undissolved quartz in the bodies *A* and *B* becomes evident at once from a glance at the two illustrations. Furthermore, the grains of free quartz differ both in character and size in the two figures. In thin section *A*, they are more or less round in shape, and rarely exceed about 0·05 mm. in diameter, whereas in *B* they

FIG. 5.
PORCELAIN *A*.

are angular, and frequently attain a diameter of 0.125 mm. and over.

By any other than the mineral-optical method, it would have been impossible to gain such insight into the structure of these bodies as is provided by these six illustrations. Furthermore, the data obtained by this method fully explain the results of the practical tests mentioned above. Material *A*, which is by far the more homogeneous porcelain of the two, would naturally be expected to exhibit a marked superiority under the heat-test, since its structure would tend to facilitate the uniform distribution of heat throughout the mass, when the piece was subjected to rapid changes of temperature. In mechanical strength also, material *A* will show up to advantage, again owing to the structural nature of the body, while, in view of its marked crystalline character, its dielectric strength will be greater in accordance with the Maxwell theory; for, in passing through material *A*, the electric current will meet, in all parts of the piece, portions which differ in the ratio of dielectric constant to conductivity. The result of these mineral-optical tests, indicates that material *A* could be employed with much greater confidence for the manufacture of electric insulators. The fact that the quartz, with its well-known chemical elasticity, is practically all dissolved, offers a much better guarantee that an insulator made from material *A* will resist in practice the disintegrating influence of all kinds of mechanical, thermal, electrical, and also, without doubt, internal chemical forces much more successfully than a piece made from *B*. This knowledge of the internal structure of a high-tension insulator will also assist in answering—presumably in the affirmative—the much discussed question of the ageing or decaying of porcelain, and will provide an explanation of the causes of the hitherto inexplicable breakdowns which so often occur in practice.

A few words of a purely chemical nature may here be added. It would have been simple either to have worked out the corresponding Seger formulæ, or to have calculated the rational analyses from the complete chemical analyses of the fired porcelains *A* and *B*. Such calculations, frequently made with the object of imitating certain porcelains, are quite useless. They do not take into account such factors as the physical conditions under which the raw bodies are built up, the behaviour of the various types of felspars when fired to high temperatures, nor the character of the clay substance, which varies so considerably in different kaolins. For example, the Halle deposit, which is of comparatively simple formation, and which has been subjected to a thorough geological investigation, exhibits at least three distinct types of kaolins, each of which is distinguishable by the peculiar nature of its clay substance. These specific types of kaolin are closely related genetically to the original rocks from which they were derived; and similar rules hold good in other deposits, *e.g.*, the Meissen and Silesian deposits. Furthermore, the percentage of alkalies in the raw bodies invariably appears to be higher than in the fired product, indicating that the alkali in the unstable felspars volatilises more or less in the kiln; and this mobility of the alkalis appears to bear a definite and direct relationship to the utility of a felspar from the ceramic point of view. This uncertainty in the determination of the alkalies—and therefrom the felspar content—in the raw body, renders such formulæ particularly unreliable. Precise information as to the felspar content of a raw body is of paramount importance to the colour of the fired product. A body made from a grey-burning clay, and containing little felspar, will, on leaving the kiln, be quite discoloured by the natural firing-colour of the clay; but such a body can readily be converted into a white-firing porcelain by the addition of only a small percentage of felspar, without in any way affecting the firing process, except in lowering to a very slight extent the maturing temperature. And since it is equally as simple, and indeed of common occurrence, to produce, through faulty burning, a discoloured porcelain from a perfectly satisfactory body, it is obvious that calculations such as those suggested above must lose still more in importance when it is remembered that every body has to be fired according to its own particular schedule. A very simple test, the importance of which rarely receives the attention it deserves, namely, the firing in an oxidising atmosphere of a small cone, prepared from the material to be tested, will demonstrate clearly how various are the demands made by a ceramic body, by virtue of the more or less unstable metal silicates which it contains, upon the skill and reliability of the fireman.

A few remarks of a practical nature may not be out of place here. Experienced foremen in the porcelain industry are accustomed to judge the value of a raw body submitted to them for a works test, by testing whether the body is sufficiently plastic to be worked up, whether it stretches sufficiently in

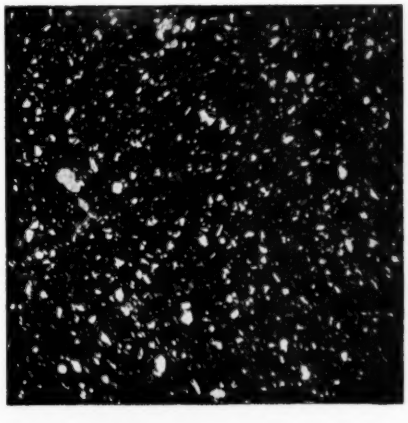


FIG. 6.
PORCELAIN *B*.

turning, whether it shows any tendency to separate out when made up into a casting slip, whether it dries rapidly enough and without excessive shrinkage, even when used in pieces composed of sections varying greatly in thickness, and finally, whether it can be fired without great difficulty to a dense, white porcelain and withstand the highest temperature of the kiln. It is, of course, well known that a compromise is necessary if all these demands are to be met. It is a simple matter to prepare two bodies, identical in rational analysis and physical composition, one of which would be highly plastic and produce a hopelessly bad porcelain, while the other, though extremely "short," would give a product of excellent quality. It is

(*Continued on page* 14)

[13] Personal communication from Dr. Köhler (Zeiss Works, Jena), May 15, 1923.

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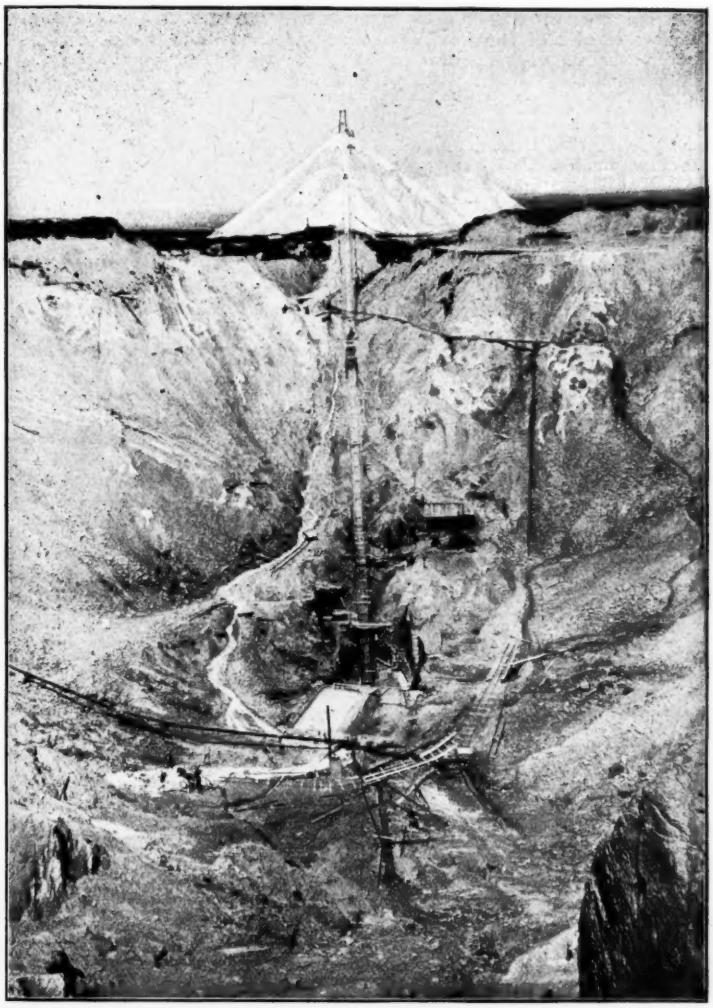

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(*Continued from page* 11)

also a well-known fact, and one which has been proved by many failures in practice, that an attempt to apply the more or less empirical methods and experiences, which have proved satisfactory in the manufacture of thin ware in the table and art porcelain branches, to the preparation of thick pieces such as are characteristic of the insulator industry, offers little prospect of success. A body may prove quite satisfactory for making small cylinders measuring 1 cm. in diameter and 4 cm. in height and may give a pure white and dense fired product; yet the same body would in most cases prove altogether unsuitable for making cylinders of the same height, but of 4 cm. diameter. It is not clear whether all these points of view received attention by Rieke[14] in his admirable work: "On the effect of the grain-size of the non-plastic material on the behaviour of fine ceramic bodies in firing," since only those changes which take place during the firing operation are described by him. If due consideration is given to all the factors which came into operation in the production of porcelain *A*, it will be seen that it would be impossible to remove entirely all traces of the free quartz in the material by prolonging either the grinding of the raw materials or the firing of the ware. Nevertheless, the nature of porcelain *A*, which was not originally intended as an insulator porcelain, can be varied so as to increase considerably its dielectric strength at the expense of its unnecessarily high resistance to the heat test, without materially affecting the mechanical strength. This could be done by suitably rearranging the body constituents within the ceramic three-phase system, clay-substance—quartz—felspar. Such a porcelain, in which the felspar content of the raw body would be as low as possible, and the quartz-content as high as possible, while the material providing the necessary clay-substance would have to be selected with the greatest care, could be prepared entirely from German materials with the exception of the felspar. The body would have a rational composition corresponding to 47 per cent. clay-substance, 35 per cent. quartz and 18 per cent. felspar, and would be highly plastic and suitable for casting in slip form. In thin section, this porcelain would be found to have lost completely its elastic structure and would appear as a homogeneous mass, closely knit together by sillimanite crystals, and showing only traces of free quartz.

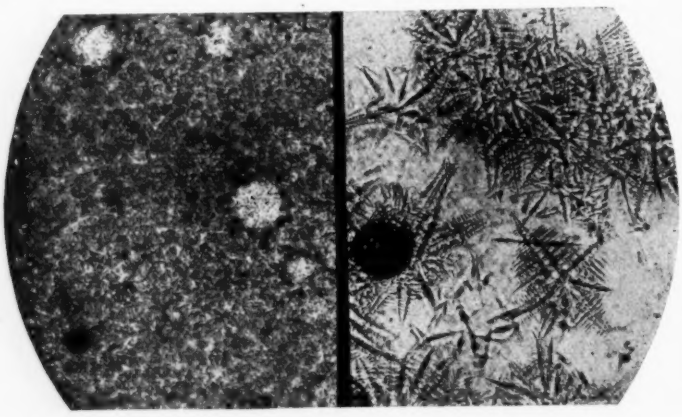

FIG. 7.
GLAZE ON PORCELAIN A.
ENTIRELY MICROCRYSTALLINE.

FIG. 8.
GLAZE ON PORCELAIN B.
HIGHLY DEVITRIFIED.

It now remains to be shown whether, and to what extent, the mineralogical microscope is capable of disclosing the internal structure, and hence the value, of a porcelain glaze.

Figures 7 and 8 are reproductions of the microphotographs of the glazes on porcelains *A* and *B*, taken with a Zeiss 8-mm. apochromatic lens, numerical aperture 0·65, "Homal" I. magnified 250 times. It is obvious at first glance that glaze *A* is a genuine microcrystalline hard glaze, whilst glaze *B* is highly devitrified. This result explains at once the difference in the behaviour of the two glazes under the heat-test, and further, it demonstrates clearly that the glaze on porcelain *B* is of faulty composition. Neither the chemical analysis of the glaze ingredients, the rational analysis of the prepared glaze, nor the corresponding Seger formulæ could furnish this information on the structure of these glazes. The Seger formulæ of glaze *A* is here given merely to indicate the type:

$$\left.\begin{matrix}0{\cdot}11\ K_2O\\ 0{\cdot}67\ CaO\\ 0{\cdot}22\ MgO\end{matrix}\right\}\ 1\ Al_2O_3 :\ 10\ SiO_2;\ \textit{i.e.},\ 1\ RO :\ 1\ Al_2O_3 :\ 10\ SiO_2$$

These optical results also explain why glaze *B* could hardly be considered as providing the necessary protection to the insulator against the weather and against chemical action. The coefficient of expansion of the crystals embedded in this glaze differs from that of the amorphous portions, so that stresses are set up within the glaze by changes in temperature. In time, these internal stresses lead to crazing of the glaze and also to the creation of stresses in the body. These inner molecular rearrangements, with the consequent internal stresses are well-known in the glass industry; in the end, portions break away from the main piece, or, in the case of thick glasses, the whole piece collapses, the stresses being in this way relieved. Partially devitrified glazes of this type tend to facilitate the collection of dirt on the surface of the insulator as a result of crazing, and, in consequence, the danger of leakages to earth is increased. After a time, the surface of the porcelain becomes rough and unsightly, and, instead of protecting the insulator, these glazes are themselves frequently the original cause of serious defects.

In the above notes, only a few of the more important possibilities of the application of the Zeiss-Winkel "ceramic microscope" are indicated, the methods and results, of interest both to manufacturers and to users, being illustrated by a comparison of two commercial porcelains. The data provided by this instrument in disclosing the nature of the internal structure of the two porcelains clearly demonstrate the marked superiority of quality *A* over quality *B*; furthermore, the reasons for this superiority are also brought out convincingly—with the same elementary precision, in fact, as is possible in the case of metals and alloys by the aid of the metallographical microscope. Moreover, it has also been shown that the ceramic microscope is the only instrument by means of which it is possible to compare, in an objective manner, the true value and reliability of two ceramic products. It may, therefore be assumed that, in future, both the maker and the user of the better qualities of porcelain will make use of the microscopical test in thin section, a test which, at present, is looked upon more or less as a curiosity. This applies with special force to high-tension technique, which, with its ever-increasing transmisssion voltages, is constantly making higher demands upon the quality of the porcelain. But it also concerns the ceramic industry, which, as a branch of the chemical industry, should endeavour to gain as full a knowledge as possible of its raw materials and of the varying reactions of one material upon another in the manufacturing processes, in order that the best possible ware may be produced in the most rational way. The wretched empiricism so often met with on high-tension porcelain works, with the inevitable losses associated with it, must exhaust prematurely the by no means unlimited supply of high-grade ceramic materials in Germany, and will shake the confidence of capital in the stability of a technique which is undoubtedly capable of high development. And this development will begin to be realised when a conscious effort is made to apply the law of mass action to the reactions taking place in the chemistry of the silicates.

[14] *Sprech*, **51**, 95, 1918.

Purifying Kaolin

THE percentage of sulphuric acid utilised to neutralise alkali in purification of kaolin must be less than that of the alkali though variable with different clays. Too much acid will increase the degree of viscosity, and thus plasticity of the slip to more than normal, and may produce a black scum on the dry kaolin. The alkalis impede filtration, as the fine particles clog the filter. Neutralised with sulphuric acid, a kaolin slip can easily be filtered.

Pottery and Porcelain

How China Clay and Stone are Used

In a lecture on this subject, given by Mr. Harry Barnard before representatives of ceramic workers at the Royal Society of Arts centre, some interesting facts relating to the use of China Clay and China stone in various grades of chinaware and porcelain were disclosed. They should prove exceedingly helpful and profitable to China Clay and stone producers who specialise in this branch of the trade. The lecturer prefaced his remarks by saying that they required to have a speaking acquaintance with the different types of ware so that they could easily distinguish between china, earthenware, and stoneware. Summarised, Mr. Barnard's main points were :

All pottery was made of clay of one sort or another—some of natural clay almost as it was found ; some of very simply mixed materials ; and some of very fine materials, very carefully and elaborately prepared by very expensive processes. There was a very real need and demand for the cheap article, which should always be as good as possible ; when it tried to look like its more aristocratic superior it became a deplorable thing.

Characteristics of Potters' Clay

With regard to the composition of clay : it was an earthy compound, characterised by plasticity—*i.e.*, it was capable of being moulded when mixed with water, and chemically it might be called hydrated silicate of alumina. It was always found mixed with other substances, and was the result of the decomposition or disintegration of rocks. Its composition varied accordingly. In some clay there was much more silica or flint and in other clay more felspar ; some could be used as it was found in its natural state, while other clay had to be altered by the addition of some ingredients that it lacked. Two qualities that were indispensable to clay were that it must be plastic so that it could be worked, and it must be durable, that was to say, it must become hard when fired. It was required very plastic for " throwing " and " moulding " for some wares ; porous when fired for such articles as water coolers and battery cells ; fire-resisting for pipkins and fireproof flooring ; capable of withstanding changes of temperature for such things as crucibles ; translucent for china, vitreous to give strength for paving tiles, and capable of resisting strong acids for chemical retorts. In each case particular attention must be paid to the mixing of the " bodies." It was difficult to say how a " body " was made up, so various were the mixtures of potters.

Materials for China " Bodies "

The materials used in making the earthenware body and the china body were flint, Cornish stone, China Clay and calcined bone. They were used in different proportions for different " bodies." The best flint was to be found in the north of France ; it had to be fired in a kiln and then crushed and ground into a perfectly white powder. Cornish china stone was a kind of granite rock, with felspar, quartz and mica in it, and was crushed in the same way as the flint, until it became a white powder. China Clay was the fully disintegrated or decomposed granite rock, and was the whitest clay known. Bone was used in making English china ; it was calcined, ground up, and made into a powder, which gave the whiteness and translucence of English bone china.

mportant China Clay and Stone Combination

There were two main divisions in pottery : the first was called hard or vitreous ware and the second soft or porous ware. In the first division were included hard or true porcelain, soft or European porcelain, biscuit porcelain or parian, bone china or English china, stoneware, including ironstone, fine glazed stoneware, unglazed jasper, basalt ware, and others. The second division contained fine faience with transparent glaze, faience with opaque glaze, common earthenware glazed, and the softer wares like terra cotta of which vases and flowerpots are made.

The discovery of China Clay and china stone together was very important to the pottery industry : because they were found together the first china was made from them. Porcelain and china were semi-fused, whereas soft wares, although made of the same materials, were not fired to a fusing point and consequently were porous and must be glazed to render them useful for liquids.

How Porcelain, China and Earthenware Differ

With regard to the difference between porcelain, china and earthenware, the term " porcelain " was one that was falsely used all the world over. Semi-porcelain, " silicon china," " ironstone," and " granite " were all trade terms used to describe different things, but not one of them was porcelain. True hard paste porcelain was ware that was translucent due to hard firing after it had been glazed. It was first of all fired sufficiently to warm it through and to make it hard enough to be handled, then it was dipped in glaze and fired to the full heat. Soft paste porcelain was translucent owing to the addition of a fluxing material in the clay, and was really an attempt to turn the clay body into a kind of glass, so that when it was fired it became a sort of thick, dense, opaque glass.

With regard to china, bone china or English china, that was translucent because it contained 50 per cent, of calcined bone. The bone combined with the silica in the clay and formed a vitreous, translucent mass at a high temperature ; the bone also had the property of adding whiteness to the body. Hard porcelain had to be fired at from 135° C. to 145° C., there being only 100° between under-fired and over-fired material. Soft porcelain, which was largely glass or frit with a small quantity of white clay put into it and with a glaze made with a red lead, nitre, sand, etc., had to be fired at 110° C. to 150° C.

English China Body

English china was made of fine ash, China Clay and china stone, the usual proportions for the best China Clay in England being 6 of bone ash, 3½ of China Clay, and 4 of china stone, with a glaze made of China Clay, china stone, boracic alkalis, and lead oxide, which was fired at from 1,200° C. to 1,250° C.

Earthenware was made from China Clay, sometimes with the addition of ball clay from Devon or Dorset, china stone and flint, but it differed from china in that it had none of the expensive bone in its composition. A rough comparison would show why china was so much more expensive than earthenware. The cost of the best china " body " was roughly about £20 per ton, and the whole process of making entailed expensive hand labour. Bone could be bought for from £43 to £20 per ton. Cheaper china was made from cheaper materials : the ware was " placed " in a much cheaper way, and if it was not straight or otherwise faulty it did not matter so much. The cost of the best earthenware body was about £4 per ton, being produced thus cheaply on account of the fact that it was mostly made by machinery.

How the " Bodies " are Made

When the raw materials come to the works they are put in heaps on the " marl bank " to weather in the sun and air. Then a certain quantity of each material is weighed out and put through a " blunger "—a large tub or vat in which it is well mixed up with water. After the materials have been through the grinding mill and the blunger, they are run down into " arks," where they are mixed together. They are then passed through sieves of lawn to the magnets. In one square inch of the lawn there are 14,400 holes, through which every portion of the body to make china or earthenware has to pass before it can go into the potter's shop. After that the " slip " is pumped up by hydraulic pressure into a clay press, consisting of wooden trays with a canvas bag in each tray, having a nozzle on the top, the trays and bags being bolted up tight. The pressure is continued until most of the water is squeezed out. When the press is opened the clay is stiff enough to be rolled up like a door mat and then has to go through a further process, known as kneading, by means of a " pug mill." It emerges from the " pug mill " in the form of a very even sausage of clay, of the proper consistency for the potter's bench, it being cut off with a wire into pieces of sufficient length for the potter to carry away to his bench. The potter's wheel is worked either by foot, hand, steam or electrical power. It is a revolving disc on which the ball of soft clay is thrown, and as it revolves the potter with deft fingers works it into the shape required. Sometimes it is necessary to finish the article on the turning machine, where it is turned on a horizontal lathe in a similar way as wood or brass is turned. It is then shaved down to the necessary size and profile and after burnishing on the lathe is ready for the decorator's hands.

Bentonite Deposits in Western Canada

THE High Commissioner for Canada in London has received from the Dominion Department of Mines the following report from Mr. Hugh S. Spence, of the Mines Branch, in regard to bentonite deposits found in Western Canada :—

Attention has been directed during the last few years to a peculiar clay found in the western parts of the United States and Canada called bentonite. The clay was first described from the State of Wyoming, and has been found also in other States of the Union, and in the Provinces of Manitoba, Saskatchewan, Alberta and British Columbia, in Canada. The Mines Branch of the Department of Mines of Canada has recently made a survey of the known bentonite deposits with a view to determining the extent to which the clay occurs in Canada.

It has been found that bentonite is pretty widely distributed in the upper sections of the Cretaceous rocks, which cover the greater part of the Prairie Provinces, and that many of the sandy or shaly beds in this series of rocks are bentonite in varying degree. The sticky " gumbo " soils of the west owe their character to the presence in them of bentonite, which swells up when wet and forms a pasty mass that makes the prairie roads at wet seasons almost impassable. The University of Alberta is at the present time conducting experimental work in the improvement of highways by counteracting the evil effects of bentonite.

The bentonite beds of the Canadian West range in thickness from a few inches to as much as 14 ft. The latter thickness is exceptional, but several deposits measuring 6 ft. to 8 ft. are known. The deposits which probably offer the best possibilities for immediate development occur in southern Saskatchewan and southern British Columbia, where beds are found quite close to railway transportation. No production from any of the deposits has yet been made, owing to the lack of a market. In the United States, however, two companies are now marketing bentonite ; one of these produces only crude clay and the other, both crude and powdered material. These companies report that the market is small as yet, but is growing steadily each year, and that an encouraging interest is being manifested in the possibilities of the clay by the most varied industries. In 1921 the Mines Branch arranged the shipment of 5 tons of Alberta bentonite to the Imperial Mineral Resources Bureau, 2, Queen Anne's Gate Buildings, London, for research purposes and for distribution in British industries. It is understood that the Bureau still has a quantity of the clay on hand.

Bentonite in the dry state looks much like any other clay. It is only when it is wetted that its peculiar physical properties become apparent. The name bentonite was given about twenty-five years ago to the clay from a bed that occurs in rocks of Upper Cretaceous age (Fort Benton series) in Wyoming, and attention was drawn to the material on account of its excessively sticky nature and its high-water absorption. It possessed, in short, the physical attributes of what are now called " colloids." Briefly, bentonite is a clay substance, the individual particles of which are so small that they are invisible even under the highest powered microscope : they are not crystalline like ordinary clay particles, and when mixed with an excess of water form what are called " hydro-sols "—that is, permanent suspensions, or dispersions, from which the clay will not settle out, even if allowed to stand indefinitely. By virtue of the relatively enormous surface presented by the particles, bentonite possesses great absorptive power, and the dry clay will absorb many times its volume of water, swelling up to a sticky jelly-like mass. The particles have the property of absorbing chemical compounds also, such as salts, dyes, etc., out of solution, and of effecting base exchange between salts of the alkali and alkali earth groups.

These properties have suggested a very wide field of usefulness for bentonite in industry. Some of the more important of these uses are : as an absorbent of dyes and colours ; to increase the strength of cements and plasters ; as a suspending agent for enamels and glazes in the metal enamelling and ceramic industries ; as a bonding agent in crucible bodies, electrical and chemical porcelain and abrasive wheels ; as a de-watering agent for petroleum, gasoline and oils generally, as well as for air and gases ; as a mordent and as a base for lake colours in the dye and colour industry ; as an accelerator and stabiliser of emulsions of various types, and in the preparation of asphalt, coal tar residues and pitch emulsions ; as an absorbent of nitro-glycerin in the manufacture of dynamite ; as a filler material for fertilisers and for paints, rubber, and moulded composition products of various kinds ; as a suspending agent in core washes for foundry work, and as a bonding agent in moulding sands ; as a sticking or spreading agent in insecticidal sprays and dusts, and to increase the wetting power of cattle dips ; as an ingredient of lubricants ; in cold water paints or distempers ; as an ingredient of adhesive pastes ; as a sizing agent for textiles, cordage, etc. ; as an ingredient of crayons, indelible pencil leads and pastel colours, and of printers' inks ; for increasing the retention of China Clay in the manufacture of paper and for removing the carbon black particles in the de-inking of newsprint ; to remove the impurities from petroleum, gasoline and lubricating oils, as well as from packing-house products and vegetable oils (acid-treated clay) ; to replace whiting in putty ; as a source of pure colloidal silica, or silica gel ; as a detergent in soaps and scouring compounds ; as an ingredient in stove polish ; in pharmaceutical products, cosmetics, facial clays, etc.

The above list by no means exhausts the many suggested uses for bentonite. Thus far, important commercial utilisation has been confined to the paper and oil industries, the latter being by far the largest consumer. The clay in this case, while probably more or less identical with bentonite, is variously termed halloysite or otalite, and is found in southern California : large quantities have been used by the Pacific Coast oil refineries, the clay being first treated with acid.

China Clay in Cotton Filling

AMONG the substances recognised as fillers for cotton goods may be included china clay. The following methods of use are of particular interest :—

Pure R. Finish.—A corn starch liquid being made, marking 8° Twaddell, it is mixed with china clay and farina in the proportion of 50 gallons for 10 of clay and 10 of farina, the mixture being softened to the required degree with soap. *Shrunk R. Finish.*—Corn starch liquid (8° Twaddell), 50 gallons; china clay paste, 10 gallons ; mineral white, 15 lb. ; white soap softener, 5 lb. *S. Finish.*—Crystal starch liquid (8° Twaddell), 50 gallons ; china clay paste, 5 gallons ; mineral white, 10 lb.; barytes, 10 lb.; good soap softener, 3 lb. *B. Finish.*—Flour, 1 cwt.; china clay paste, 20 gallons ; thinned with water. *Madapollam Finish.*—Generally a dull foreign finish, full and soft to touch. Flour paste, 12 gallons ; china clay paste, 4 gallons. *Canton Finish* (dull).—china clay paste, 20 gallons ; mineral paste, 5 ; starch paste, 50 (12° Twaddell). *China Finishes.*—Heavily weighted hard and bright finishes for Chinese and Egyptian markets. Starch, 10 gallons (12° Twaddell) ; china clay paste, 4 ; mineral, 1. All is boiled to 60° C. (140° Fahr.). *New China Finish.*—Filled both face and back. Face filling, starch (10° Twaddell); back filling, china clay paste, 20 gallons ; mineral wet, 5 ; starch, 20 gallons (12° Twaddell) ; flour paste, 20.

Pattern Finishes

For 18 by 18 cloth.—Farina, 2 gallons; china clay (wet), 2 gallons ; water, 4 ; softener, 6 lb. Heat to 82·2° C. (180° Fahr.), and add 2 gallons of water.

Among special finishes the undermentioned may be noted : *White Shirtings* (19 by 21 cloth).—Starch, 50 lb.; water, 2½ gallons ; china clay paste, 3 gallons, with 4 of water previously added ; glycerine, 1 quart and blue to shade. *Fine Shirting* (21 by 21 cloth).—Starch, 50 lb.; water, 2½ gallons ; china clay paste, 3 ; water 4, and glycerine 1 quart and blue to shade. *Zephyrs and Counterpanes.*—Best potato starch, 44 lb.; china clay, 33 lb., the latter being first steeped in water for a few hours. When well mixed add dextrine, 33 lb., adding water to bring all to 77 gallons. When this is boiled, pure tallow, 4 lb., and blue, 5 oz., are added.

Low grade cloth, particularly for export, is often weighted with a mixture of sago, 9 lb.; rice flour, 9 ; farina, 15 ; china clay, 45 ; ultramarine, 2 oz.; soluble oil, 2½ lb.; water, 80 gallons. All is boiled until perfectly mixed. For a finer weighting mixture.—Starch, 15½ lb.; farina, 15½ ; china clay, 10 ; soap, 2 oz.; glycerine, 2 oz.; ultramarine, 4 oz.; water, 35 gallons, may be used.

China Clay Notes and News

Gardening Society's Exhibition

Mr. Frank Parkyn, the founder and principal of the well known China Clay firm of Parkyn and Peters, was this year's president of the St. Austell Cottage Gardening Society, whose successful seventy-sixth exhibition was held on July 31. Mr. Parkyn took keen interest in the success of the show and himself was responsible for a non-competitive exhibit of choice fruits, which were afterwards sent to the Cottage Hospital. Among floral exhibits was a magnificent array of plants, including some fine specimens of *lilium auratum*, staged by Mr. Henry Stocker, a director of English China Clays, Ltd.; another director, Mr. Martin Hitchins, himself an expert horticulturist, arranging a splendid show of plants and begonias for his aged mother, Mrs. Hitchins, of Trevarrick, a regular supporter of the show.

At the annual meeting of the Society, Mr. D. H. Shilson, the veteran hon. treasurer, formerly legal adviser and steward for Sir Charles Graves-Sawle, a China Clay landowner, introducing the President, referred to Mr. Parkyn's help in good causes and to the satisfaction he must have in seeing such a good show during his presidency. Mr. Parkyn, in the course of an interesting address, said the art of gardening was an excellent index to the height of civilisation to which mankind had attained. The greater the civilisation, the greater was the fondness for gardening. While they celebrated the seventy-sixth exhibition of the Society they might well be proud of the fact that it ranked among the oldest of such organisations in the kingdom. Very great credit was due to the officers and committee, who had stuck to their posts for so many years, to the great benefit of the district, and in particular their indefatigable secretary, Mr. Sydney Hancock.

He would like to see more attention paid to the cultivation of mushrooms, salads and herbs. Mr. Parkyn, who is something of a connoisseur of the table, interested the company by describing the art of making a good salad. The salt should always first be dissolved in a spoonful of vinegar—white vinegar for choice—then mixed with oil on a plate and the whole mixture poured over the salad, instead of the oil poured on first and the salt added. He thanked them for the honour of electing him their president for the past year.

Mr. J. W. Higman, of John W. Higman and Co., another China Clay merchant who takes a keen interest in the Society, moved the election of a gentleman whom he described as a member of a well known county family—the Hon. Victor Agar-Robartes, son of Viscount Clifden, another China Clay landowner, whose mineral rights Tehidy Minerals, Ltd., acquired a few years ago.

The veteran secretary, Mr. Hancock, Viscount Clifden's agent and well known in China Clay circles as a director of Associated China Clays, Ltd., who has been associated with the Society in an official capacity for 54 years, responding to a vote of thanks to the officials, amused the audience by relating how he had been refused admission to the show by one of the policemen at the entrances, who would not accept his assurance that he was the secretary, with the result that he had to make a detour of the grounds before he could gain admission. He confessed himself taken aback, especially when the constable said he would take him in charge if he attempted to climb over. He accounted for the incident by explaining that the policeman was a stranger to the locality and was doing his duty by the action he took, seeing he (Mr. Hancock) had no badge to identify him.

China Clay Works Fatality

An unusual accident occurred at Messrs. H. D. Pochin and Co.'s Gunheath China Clay works last month, as a result of which Andrew Stephens, 61, died in St. Austell Cottage Hospital. At the inquest conducted by Mr. E. W. Gill, deputy coroner, the works foreman, Capt. Wm. Kellow, said deceased's duties were to examine, oil and grease the pulleys coming from the engine house and to see that the pulleys were right on the incline. Stephens, who had done that sort of work for three years, started duty at 7 a.m. Witness was at the bottom of the pit when the man at the top whistled. He went up the incline and found deceased lying on a ledge about 20 feet from the incline with a scalp wound. The incline was about 1 in 3. Stephens fell about 20 feet.

In reply to Mr. King, Inspector of Mines, witness said deceased was an active man. It took the skip about 2 min. 45 sec. to go over the incline. Stephens was examining or greasing the pulleys. There was a certain amount of danger in greasing the pulleys when working, but none when the skip was stopped. Deceased had been instructed not to grease the pulleys when the skip was running.

Caleb George Robins said he was working at the head of the stenting plant when he saw a man's hat come truckling down the incline between the rails. On his partner and himself going up the incline they found deceased lying face downwards. He thought the skip must have struck the deceased, as he had a wound on the top of his head.

Dr. J. S. Moore, describing deceased's injuries, said a large portion of bone had penetrated the brain, to which death was due. A verdict of accidental death was returned by the jury.

Link with China Clay

Another link with the early days of the China Clay industry has been broken by the death of Miss Ann Stocker, of Glenview, St. Austell, in her 95th year. Miss Stocker was a daughter of Mr. Edward Stocker, Sen., who was one of the pioneers and founders of the West of England China Clay Co., a family concern until its amalgamation with Messrs. Martin Brothers and the North Cornwall China Clay Co. under the present style and title of English China Clays Ltd. Miss Stocker was a sister of the late Mr. Thos. Stocker, father of Mr. T. Medland Stocker, managing director of English China Clays, and of the late Mr. Edward Stocker, father of Mr. Henry Stocker, director of English China Clays. The family mourners at the funeral were Major E. Gaved Stocker, Messrs. Edward Weekes, Harry Martyn, H. Stocker, T. Medland Stocker, Capt. Ernest Stocker, G. H. Grenfell, Dr. A. Shaw, Tom Shaw, Dr. Moore, J. R. Gaved, Cecil Stocker and Frank Parkyn.

China Clay Development Enveloping House

In consequence of a China Clay worker named W. Martin declining to quit his house he was summoned by the Lambe Estate for possession, as it was required to make way for developments by Great Treviscoe China Clay Co. It was stated that the house was not in a tenantable state of repair and was now so near the edge of a sand burrow that it was in danger of becoming overwhelmed. Mr. Samuel J. Dyer, agent to the estate and a well known China Clay merchant, gave evidence in support of the summons. Defendant said the reason he had not quitted was because he could not find another house. The St. Austell magistrates ordered Martin to give up possession in 28 days.

Why American Kaolins Vary

The secret of the success of English China Clays has been the uniformity of their physical properties, and it is the efforts of those interested in the development of American kaolins to produce a product of equal reliability that has revealed the inferiority of the latter. In seeking the probable causes of variation in physical properties of American clays of the kaolin variety, an American geologist suggests that such variation is due to the variable conditions under which the deposits were laid down, the denser and harder clays having been formed under conditions of complete deflocculation and disintegration of clay grains, whereas the clays of lesser density and tensile strength have probably been deposited while the grains were in a more flocculated and coagulated condition. In other words, the extent of dispersion at the time of deposition has affected the physical properties of the clay. As a result the clay from particular mines investigated showed that in one case it was hard and weak and must be finely ground before it would blunge satisfactorily with water; another produced soft, mealy clay which was easily blunged with water without any preliminary treatment; and still another yielded a soft, highly plastic, and strong clay which contained irregular layers or pockets of fine-grained flinty clay of low tensile strength that was so hard that much of it had to be thrown away, as it would not blunge in the washers. The harder clays contained less impurities than the softer ones, indicating that nature had deflocculated some clays and caused the impurities to settle out more readily.

The Overshot Water-Wheel

Some Observations and Practical Hints by "China Clay Captain."

VERY early in the history of China Clay mining the overshot water-wheel formed a part of its machinery and plant. It was originally used both for pumping and winding, nowadays it is chiefly found harnessed to a pump, although at some places it supplies the power for the sawmills and turning lathes of the timber yards or working the "pug-mill" of the brickeries connected with the China Clay industry. Also in the allied industry, china stone, it is rather extensively used for turning the grinding pans.

We have seen newspaper articles on the subject "Water power not sufficiently utilised in this country." We believe the charge in general to be true, but it is not true of *one* valley in the clay district, where in a stretch of just over two miles fifteen water-wheels may be seen at work. Instead of fifteen water-wheels probably the modern engineer would prefer the small and powerful brother of the overshot wheel—namely, the turbine—to transmit the energy in the water via dynamo-cable-motor to useful work. There is something to be said for that where the sudden fall of the ground is peculiarly adapted for such a system, but in the valley mentioned, where the fall is gradual, and the water flows 300 yards to gain enough "fall" for a 30 ft. diameter wheel, and having to pass through different lords' lands, it would need a comprehensive scheme to make it a success. The time probably will come with a further amalgamation of clay companies and clay property owners when a great central power station will be built utilising all water power available, supplemented by the latest internal combustion engines, supplying power to all and sundry at so much per unit to the clay mines, quarries, mills and villages for light and heat. Until that time the old-fashioned, simple yet effective, "overshot water-wheel" will continue. So a short description showing how it is harnessed to a pump, how to find its horse-power, will possibly be of interest to anyone engaged in China Clay mining.

Horse-Power

The h.p. of an overshot water-wheel is found by the following equation :

$$\text{H.P.} = \frac{WD}{55{,}000}$$

Where W = weight of water *in lbs.* passing over it per minute,
D = diameter of wheel *in feet.*

55,000 is taken instead of 33,000 to get *actual* h.p. direct, as it is only 60 per cent. of the theoretical h.p.

The best way to explain very often is by taking an example. For instance, if we have a water-wheel 30 ft. diameter, 4 ft. abreast, the launder conveying the water to it may be—and often is—3 ft. wide, having a constant depth of 8 in. The average speed of the stream flowing through being 200 ft. per minute the cube of this in cubic feet multiplied by 62½ will give the weight in *lbs.* passing over per minute. Figured out this equals 25,000 lb. Now using the formula

$$\text{H.P.} = \frac{25{,}000 \times 30}{55{,}000} = 13\tfrac{7}{11} \text{ h.p.}$$

Some have an idea that if the water strikes the top of the wheel with a rush it does more work because of the impact, but the impetus given is very slight compared with the work done by the fall of the water. The water-wheel is really a continuous lever of the first order. In a wheel of 30 ft. diameter there are probably about 70 buckets, half of these when the wheel is working are in action, that is, loaded or partly loaded with water. The front bucket that is in a horizontal line with the axle centre has a fulcrum of nearly 15 ft., the buckets immediately above and below it nearly 10 in. less; the remaining 16 pairs drop back the same distance. The sum of these if the weight in each bucket was known could be calculated in lb.-ft., and form one side of an equation. The "weight harnessed" multiplied by length of crank would form the other. From this it could be shown that the work is done through the weight of water bearing down on the ends of a continuous series of levers.

Looking at it another way from the principle of work, we know weight by height equal ft.-lb. of work lifted; so inversely 60 per cent. of the potential energy in the water, by virtue of its height and weight, can be turned into useful work through the medium of the water-wheel.

When connected to a pump the circular motion of the crank is through the "logger-head" and sweep rods turned into a reciprocating rectilinear one. To regulate or equalise the pull a balance box containing approximately half the weight of pump-main-rod is fixed opposite the pump. The energy stored in the massive wheel itself tends to steady and help around dead-centres. As to the best rim speed it depends on the diameter of the wheel. A 30 ft. wheel going 8 revs. per min. gives a rim speed of just over 8½ miles per hour, which for pumping seems a pretty average speed.

A wheel only 20 ft. diameter would have to make 12 revs. per min. to give that, smaller wheels, of course, more. There are generally other factors, such as a long or short "run of rods," whether heavily weighted or not, etc. Generally speaking, it is better to have a large plunger ram going from 6 to 8 double strokes per minute than a small pump driven faster. A point to note in designing the wheel-pit is to have clearance or "run" for the water to flow out, as a water-logged wheel loses a great deal of its power; in fact, it is like a wagon with the brake on.

From what we have written we think any clay manager who has a stream with the necessary fall available near his mine, will see that it would be a paying proposition to instal a water-wheel if only to pump out the bottom water. Harnessed to a Cornish pump it does not need a driver to stay alongside it, but works on its own the whole week round.

Paper Fillers and Loaders

UNDER the above we understand substances such as clay, talc, gypsum, precipitated chalk, asbestos, pearl hardening, heavy spar and witherite. The fillers just mentioned, with perhaps others not named here, are sold under all kinds of names. Certain colours, such as amber, ochre, red oxide, etc., also increase the ash of the paper. The loading effect of these materials is, however, only an incident, and as the colouring value of same is their real purpose, no further consideration will be given these substances in this paper. Filling and loading agents are added to the paper for several reasons.

Fillers tend to increase the weight of the paper, improve the feel, make a better printing surface, enable the paper to obtain a better finish on calendering, make it more opaque, and also enable same to take the printer's ink better.

A filler is, therefore, not to be considered as an adulterant with the exception of one single instance, in connection with which a very cheap paper is demanded.

The kind of loading material to be used depends on the grade of paper to be made and the qualifications which the latter has to possess.

The principal qualities a filler has to possess are: colour and fineness.

Absence of Grit, Iron, Calcium Carbonate, Mica and Moisture

The colour must be as pure a white as possible. In judging the colour of clay or talc, it is advisable to make sure that the white colour has not been artificially improved through the addition of a blue colouring matter, very often ultramarine blue.

The fineness of the filler is very important, as in regards to its retention. This, of course, does not alone determine the degree of retention. Other factors in this respect are :

The kind of stock used. Slow or free beating stock, a thick or thin sheet, light or heavy suction, as also the amount of rosin size used.

The fineness of the loading agent is best determined with the help of the microscope.

It probably will be of interest to you to know of the results of an experiment made, as to the loss of filler taking place at different parts of the paper machine in a mill in Germany. The ash in the air dry stock at various points was as follows :

Stock from the chest	20·0%
Stock just before suction boxes	19·0%
Stock after the couch	15·0%
Stock after the first press	14·0%
Stock after the second press	13·5%
Finished paper	13·0%

The stock was 25 per cent. sulphite and 75 per cent. ground wood. Weight of paper was 50 grms. per square metre.

The retention of filler fluctuates between 30 and 90 per cent. of the amount originally added, 50 per cent. is to be considered satisfactory.

Grit, if present in any considerable amount, will cause unnecessary wear of the wire felts and jackets, also will make pinholes and possibly may give serious trouble in printing.

Grit is best tested for, by either the flotation process or placing a certain amount on a standard mesh screen and washing it with a spray of water until the water running away is perfectly clear. As to the amount of grit to be allowed, nothing can be stated, as to my knowledge no standard has been set up.

Mica has the same bad effects on paper as grit of another nature, besides producing shining spots on the paper.

Iron should be present in as small an amount as possible for the same reason as in all other paper-making material. Iron in the paper, introduced with the filler or in any other way, will form with resinous matter in the paper a resin-iron salt which will cause the paper to turn yellow in a short time. Two per cent. oxide of iron should be the maximum in clay.

Calcium carbonate is the next thing to watch for. This particular article is liable to cause considerable trouble by producing foam plentifully and increasing your alum consumption sky high. You should not find over 4 per cent. calcium carbonate.

Now, let us give the moisture some consideration. Very little attention have we given to that matter, but nevertheless we should. An experiment made by James Strachan gave the following results :

A sample of absolutely dry China Clay, weighing 100 grms., exposed to an atmosphere with an average relative humidity of 88°, absorbed moisture as follows :

In 1½ hours	0·35 grms. moisture
In 3 hours	0·5 grms. moisture
In 6 hours	0·74 grms. moisture
In 11 hours	1 grm. moisture

The clay was exposed in a shallow tray and turned over every day. Clay has been found to contain as much as 12 per cent. moisture, and as shown above, only regains, after drying on the paper machine, 1 per cent. moisture, in this case a loss of 11 per cent. only through moisture would be suffered.

Loading agents reduce the strength of paper, hence when the paper must have a certain strength and filler has got to be used, a better fibrous stock must be employed, and more care used in the making of the paper.

The ink resistance is another thing impaired by the filler. In order to keep the proper sizing effect more rosin size must be be used.

To enable you to determine the kinds of filler used from the ash of the paper, it is essential to know the chemical composition of the various fillers. As an example, the analysis of one sample of English and American clay may be given :

	English.	American.
Silica SiO_2	45·92	45·67
Aluminium Al_2O_3	38·43	37·86
Ferric Oxide Fe_2O_3	0·71	1·48
Lime CaO	1·18	0·05
Magnesia MgO	0·21	0·01
Alkalis K_2O	0·78	0·80
Total water	12·77	13·22

The other loading agents named are :

Gypsum, a natural calcium sulphate $CaSO_4\ H_2O$.

New China Clay Company

THOMAS OLVER AND CO., LTD., is the name of a new company that has been registered with registered offices at the Bull Ring, St. Austell. The company, which is a private one, has been formed to acquire and carry on the business of ground china stone and China Clay producers and merchants, now carried on at Trevear, Tregargus, and Gwindra, St. Stephens-in-Brannell, Cornwall, under the style of Thomas Olver and Co. Nominal capital : £21,600, in 21,600 shares of £1 each. Directors : J. Lovering, Cosganne, St. Austell ; R. G. Barnes, Baston, Hayes, Kent ; H. H. Truscott, Court, St. Stephens, St. Austell ; P. M. Coode, Wentworth, St. Austell. Qualification of directors : £100. Remuneration of directors voted by the company.

July China Clay Deliveries

JULY made some recovery from the heavy drop in deliveries in June—compared with preceding months—there having been an increase over the previous month of 9,000 tons. The trade was done through the following channels :—

	tons.
Fowey (including 4,424 tons china stone, but excluding 8,005 tons ball clay) ..	57,948
Par (including 890 tons china stone) ..	4,611
Charlestown	2,155
Plymouth (excluding 1,244 tons ball clay)	115
Direct by rail to destination	4,397
	69,226

compared with 60,261 tons in June.

The total of all consignments for the seven months ended July (china clay 455,808 tons, china stone 28,653 tons, ball clay 23,142 tons) was 507,603 tons, compared with 485,460 tons for the corresponding period last year, the different sections being similarly lumped. An unusually large quantity of ball clay from Devon has this year been shipped through Fowey. If the liberal allowance of 10,000 tons is made from last year's figures as representing ball clay deliveries (included in last year's figures) against the 23,142 tons actually returned in this year's figures, the resulting total of 484,461 tons representing china clay and china stone deliveries this year, is still nearly 10,000 tons above last year's figures. We hope next month to be in a position to give the dissected figures of china clay, china stone, and ball clay for 1923, so that exact comparisons can be made with the figures of the different classes this year. Well ahead as this year's figures are, they are still far below the normal pre-war average.

Removal of Sulphur from Clays

IN the course of a general investigation of the oxidation of ceramic wares during firing, being conducted by the Interior Department at the Ceramic Experiment Station of the Bureau of Mines, Columbus, Ohio, a study has been made of methods of removing sulphur from commercial clays as rapidly as possible. A rapid heating above 1,200°F. causes fixation of sulphur and consequent swelling and coring of the ware and therefore cannot be used. A rapid passage of oxidizing gases between 800°F. and 1,000°F. will rapidly remove sulphur to a great extent from open textured clays. Certain shales do not yield much of their sulphur by this treatment. The addition of powdered coal to these shales during the forming process improves, to some extent, the elimination of sulphur when a rapid atmosphere is passed.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

FOREST CHINA CLAY WORKS, LTD., London, E.C. Reg. July 9, £5,000 debenture, to Morris Katz, 167, Oxford Street, W., merchant ; general charge.

JENKINSON (C. H.) (BRADFORD), LTD., paper manufacturers. Reg. July 9, £1,000 debentures ; general charge.

London Gazette

Companies Winding Up Voluntarily

C. ANSELL PAPER CO., LTD. A. E. Mist, 189, Upper Thames Street, London, E.C., appointed liquidator.

SEATON BRICK AND TILE CO., LTD. William Laird Clark, C.A., 222, Union Street, Aberdeen, appointed liquidator. Meeting of creditors at the liquidator's office on Monday, August 18, at 12 noon.

Shipping and Export News of the Month

We give below the latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Par Harbour Shipping—July, 1924

Arrivals

Date.	Vessel.	From
July 1,	S.V. *Alzina*	Plymouth
July 4,	S.V. *Ada*	Port Houstock
July 5,	S.S. *Norrix*	Exeter
July 7,	S.V. *Emily Warbrick*	Falmouth
July 7,	S.V. *Buttercup*	Falmouth
July 8,	S.V. *Guiding Star*	Falmouth
July 8,	M.V. *Wessex*	Falmouth
July 9,	S.V. *Hero*	Falmouth
July 13,	M.V. *Mary Jones*	Southampton
July 14,	S.V. *Regina*	Plymouth
July 15,	S.S. *Trelaigh*	Portreath
July 15,	S.V. *Henrietta*	Port Houstock
July 15,	M.V. *Antigoon*	Port Talbot
July 15,	M.V. *Triumph*	Fowey
July 16,	M.V. *Katie*	Teignmouth
July 18,	S.V. *Louise*	Cardiff
July 18,	S.S. *Magrix*	Truro
July 18,	S.V. *Bidsie and Belle*	Newport (Mon.)
July 19,	S.S. *Letty*	Shoreham
July 19,	S.V. *Alfred Rooker*	Falmouth
July 21,	S.V. *Alzina*	Plymouth
July 22,	S.V. *Flying Foam*	Runcorn
July 23,	S.S. *Trader*	Kingsbridge
July 23,	M.V. *Queen Phillipa*	Truro
July 25,	S.V. *R. Passmore*	Polperro
July 27,	S.V. *Rita*	Southampton
July 28,	S.V. *Henrietta*	Mevagissey
July 28,	S.V. *Ivy*	Port Houstock
July 29,	S.V. *Rhoda Mary*	Newlyn
July 30,	S.S. *Katherine*	Plymouth
July 31,	S.V. *Marian*	Falmouth

Sailings

Date.	Vessel.	Destination.
July 1,	S.V. *Western Lass*	Goole
July 1,	S.S. *Goliath*	Fowey
July 5,	S.V. *Glenway*	Rochester
July 7,	S.V. *Alzina*	Plymouth
July 7,	S.S. *Norrix*	Gravesend
July 12,	M.V. *Wessex*	Guernsey
July 14,	S.V. *Buttercup*	Gloucester
July 14,	S.V. *Guiding Star*	Runcorn
July 15,	M.V. *Marie*	Tayport
July 15,	S.V. *Rose*	Leith
July 15,	S.V. *Hero*	Runcorn
July 15,	S.V. *Ada*	Runcorn
July 17,	S.S. *Triumph*	Plymouth
July 17,	S.V. *Mount Blairy*	Charlestown
July 20,	M.V. *Mary Jones*	Runcorn
July 22,	S.V. *Regina*	Pentewan
July 23,	S.V. *Henrietta*	Goole
July 22,	M.V. *Antigoon*	Ternúsen
July 22,	S.S. *Magrix*	Grimsby
July 23,	S.V. *Letty*	Fowey
July 23,	S.V. *Bidsie and Belle*	Fowey
July 24,	S.V. *Alzina*	Pentewan
July 26,	M.V. *Queen Phillipa*	Rochester
July 28,	S.S. *Trader*	Gravesend
July 30,	S.V. *Louise*	Penarth
July 30,	S.V. *Alfred Rooker*	Runcorn
July 30,	S.S. *Katherine*	Pentewan

Charlestown Shipping—July, 1924

Arrivals

Date.	Vessel.	From
July 4	*Jerseydene*	Plymouth
July 7	*St. Paul*	Plymouth
July 9	*Desag I*	Fredrikshamn
July 14	*Louistic*	Cardiff
July 17	*Lady Daphne*	Truro
July 17	*Mount Clairy*	Par
July 17	*Leonard Piper*	Torquay
July 20	*Isabella*	Rouen
July 23	*Amanaa*	Ardrossan
July 29	*Innisulva*	Cardiff
July 29	*W. A. James*	Cardiff
July 30	*Marena*	Cardiff
July 30	*Gertrud*	Trangsund

Sailings

Date.	Vessel.	Destination.
July 5	*Jerseydene*	Preston
July 8	*St. Paul*	Granton
July 18	*Desag I*	Kotka
July 21	*Lanistic*	Nantes
July 23	*Lady Daphne*	Rochester
July 21	*Mount Clairy*	London
July 23	*Leonard Piper*	London
July 22	*Isabella*	Antwerp
July 31	*Innisulva*	London

Par Harbour Tide Table, August, 1924

(*British Summer Time Throughout.*)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Friday	1	6.47	7. 5	11. 8
Saturday	2	7.23	7.41	11. 9
SUNDAY	3	7.57	8.14	12. 1
Monday	4	8.32	8.50	12. 3
Tuesday	5	9. 8	9.27	12. 2
Wednesday	6	9.46	10. 6	12. 0
Thursday	7	10.27	10.51	11. 7
Friday	8	11.15	11.44	11. 0
Saturday	9	—	0.14	10. 8
SUNDAY	10	0.49	1.27	10. 7
Monday	11	2. 6	2.48	11. 2
Tuesday	12	3.27	4. 5	12. 2
Wednesday	13	4.38	5. 9	13. 1
Thursday	14	5.38	6. 5	13.10
Friday	15	6.29	6.55	13. 4
Saturday	16	7.18	7.39	13. 1
SUNDAY	17	7.59	8.17	13. 1
Monday	18	8.36	8.55	12.11
Tuesday	19	9.10	9.30	12. 6
Wednesday	20	9.46	10. 3	11. 9
Thursday	21	10.20	10.41	11. 1
Friday	22	11. 0	11.24	10. 3
Saturday	23	11.50	—	9. 7
SUNDAY	24	0.21	0.57	9. 3
Monday	25	1.36	2.17	9. 5
Tuesday	26	2.56	3.32	10. 2
Wednesday	27	4. 4	4.33	11. 1
Thursday	28	4.57	5.20	12. 0
Friday	29	5.43	6. 3	12.10
Saturday	30	6.21	6.40	13. 3
SUNDAY	31	6.59	7.18	13. 0

E. CLEMENS, Harbour Master.

China Clay and Stone Statistics—July, 1924

THE following are particulars of China Clay and china stone, forwarded from Devon and Cornwall stations for shipment at the following ports and also for conveyance to inland towns by rail throughout during the month of July. Interesting comparison is made with the figures for July, 1923.

SHIPMENT TRAFFIC, JULY, 1924 AND 1923.

Port.	China Clay.		China Stone.		Ball Clay.		Total.	
	1924.	1923.	1924.	1923.	1924.	1923.	1924.	1923.
	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons
Fowey	53,524	43,955	4,424	3,025	8,005	1,700	65,953	48,680
Newham	—	—	—	—	—	—	—	—
Par	1,819	864	904	98	—	—	2,723	962
Plymouth	115	—	—	—	514	76	629	76
Cattewater	—	—	—	—	730	469	730	469
St. Blazey	987	1,074	—	—	—	—	987	1,074
Sutton Hbr.	—	—	—	—	—	31	—	31
	56,445	45,893	5,328	3,123	9,249	2,245	71,022	51,292

INLAND TRAFFIC BORNE BY RAIL THROUGHOUT.—July this year, 4,397; last year, 4,976: decrease, 579 tons.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

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Contents

PAGE
EDITORIAL NOTES 7
China Clay Workers at Wembley 8
Death of Mr. Marshall Stocker 9
China Clay Producers 10
Alum and Alum Cake 11
The Filter Press 11
China Clay as Refining Agent 14
Kaolin Deposits at Furtei, Sardinia 15
China Clay Notes 17
Shipping and Export News 19–20

The China Clay Association

NEWS which we print in another part of this REVIEW of the break-up of the Associated China Clays, Ltd., is of the gravest importance to the industry as a whole, and will have far-reaching effect in consequence of the price-cutting war which will ensue. We have, as our readers know, several times urged members to pull together and preserve the interests of the trade, so that the crisis which has now arisen might have been avoided. As it is, only the strongest firms will be able to withstand the war which is now bound to cause so much distress in the trade. One of the results of this break-up may be the combining of the interests of some of the largest firms. There can be no doubt that some of the smaller firms who, even in the best of times, have had difficulty in carrying on, will now find even greater difficulty than before, and only those firms who have the highest quality of clay may survive, as competition scarcely affects them. We can only hope that the Continental demand for China Clays, now that there is a more favourable political outlook, may increase, and thus somewhat help the situation. We have consistently urged the necessity for greater publicity by individual firms in the past, and now that the crisis has arisen it cannot be too strongly pointed out that to retain trade under price-cutting competition no effort should be spared in this direction.

Wembley and China Clay

OVER one thousand two hundred employees and friends of English China Clays, Ltd., visited Wembley Exhibition on September 6 last. Undoubtedly a very large number of others from the Cornish and Devon clay districts have also done so, though this is perhaps the largest party from the district directly connected with the China Clay industry. Thanks to the generosity of the firm and the admirable arrangements made, the visit proved one of absorbing interest, and many of the visitors must have come away impressed with the might of the Empire, and incidentally learnt a great deal of the different processes for which China Clay is supplied. The paper-making machine actually at work offered an especial interest, for although it is common knowledge that so much China Clay is dispatched to the paper mills it is doubtful if many of the China Clay workers had ever before seen a paper-making machine at work. The pottery section, too, was visited by many Cornishmen, and the examples of pottery displayed at Wembley were much appreciated. The chemical section was also visited, and here the China Clay visitors must have wondered how much of their produce entered into some of the display. The dump of China Clay at the Malayan exhibit and the rather crude pottery had much attention, and many were the remarks passed by the practical workers on the difference of the clay shown and our own English China Clay.

The day proved a fine one, and there can be no doubt that the Cornish China Clay workers thoroughly enjoyed a unique experience. The educational advantages of such a visit must be immense, and English China Clays are to be congratulated on their part in providing and organising such a successful and enjoyable visit.

The Uses of China Clay

THE demand for China Clay in the paper mills and potteries and its usefulness in the textile trade have been so great that there has been comparatively small effort made to introduce it elsewhere. Manufacturers of many classes of goods might profitably consider the matter and see if they are not overlooking a material at their very doors which could take the place of more expensive chemicals. It comes as a revelation to many that in China Clay we have an absolutely *pure* substance, with every grain smooth and soft. It is an ideal base for chemicals which need dilution before handling, or for colours too concentrated to be used by themselves. It does not deteriorate or disintegrate with time, and may be kept equally well in or out of doors. It is insoluble in water, and unaffected by ordinary acids or alkalis with which it may chance to come in daily contact. Not only is it harmless to touch, but actually gives a healthy smoothness to the skin. It has a tendency to unite with grease, and enginemen in the China Clay works may sometimes be seen using it in place of soap.

A word of warning should, however, be given to those who may desire to experiment with China Clay for various purposes, for although on analysis China Clay is found to be composed of elements in definite proportion it has varying physical properties, and China Clay which may be perfectly suitable for the purpose desired, mined from one pit, may be just as unsuitable when mined from another. Manufacturers are advised to obtain the assistance of the producer, telling him candidly for which purpose they require the clay, and they will thus obtain the expert assistance of the practical producer and his research staff in obtaining the most suitable clay for their purpose. Amongst the by-products of China Clay works are all the essentials for supplying silica bricks and tiles of the highest quality. Lee Moor, for example, are supplying fire bricks which have a reputation for very high quality and are much in demand. We have frequently published a list of manufactures in which China Clay plays a part, and if Cookworthy (the discoverer of China Clay in this country) was alive to-day he would be surprised at the variety of uses to which the substance could be applied over and above its use in the paper mills and potteries. Much alum has been extracted from it by sulphuric acid; copying pencils, many paints and colours are prepared with it, etc., and now, with the advent of "colloidal" China Clay, still further use may be found.

China Clay Workers at Wembley

English China Clays, Ltd., Employees' Trip

On Saturday, September 6, the works employees and the office staff of English China Clays, Ltd., paid a visit to the British Empire Exhibition at Wembley. Mr. T. Medland Stocker, joint managing director of the firm, was responsible for originally suggesting the trip, the proposition being heartily agreed to by all the directors. The cost of the return journey to the men was only 9s. 6d. each, the company giving a subsidy of 10s. each man.

Making arrangements for so large a party proved no light task, but the scheme was very capably managed by Mr. H. S. Andrew and Mr. Alfred Davies, in connection with local committees composed of captains and men of the various works. Simple printed instructions were also issued to each of the party so as to avoid confusion. Long before the date of the trip it had been anticipated with great excitement, and frequent references to Wembley and the outing were heard from the men at the various works and dries, very few of whom had been to London, and some of whom had never been in a train, many others having travelled only very short distances. The party numbered nearly 1,300 and was drawn from all the company's various works, stone quarries, and mills, numbering about 30, in Mid and North Cornwall and Devon. The men, some of whom took their women folk, were accommodated in two special trains, starting from Burngullow station at 11.30 and 12 o'clock on the Friday night. The first train, in charge of Mr. Alfred Davies, picked up 499 men at Burngullow, the number being increased to about 700 by the St. Austell contingent. At St. Austell station, Mrs. T. Medland Stocker attended with her daughters, and brought baskets of apples for distribution among the trippers, a kindly act that was much appreciated during the journey.

The rest of the party, who were under the supervision of Mr. H. S. Andrew, assisted by Mr. G. H. Grenfell, were in the second train, which also picked up the North Cornwall party under Capt. Hancock, at Bodmin Road station, and the Devon men in charge of Mr. Mead King, at Plymouth North Road, Plympton, Cornwood and Ivybridge.

Too excited to rest or sleep, most of the men passed the hours by smoking and walking up and down the length of the train in the corridors, one party calculating they had done a four miles walk in this way.

Paddington was reached at 7.5 a.m., the second train arriving nearly an hour later. The party were met at Paddington by Mr. T. Medland Stocker, Mr. Reginald Martin and Mr. Walter Sessions, the managing directors of the company, and Mr. M. F. Hitchins, a director. Mr. Sessions was not sufficiently recovered from his recent illness to take any active part in the proceedings.

Motor Tour through London

After a hurried breakfast, between 700 and 800 of the party set out in 25 previously chartered omnibuses for a tour of London, and later proceeded from Baker Street Station to Wembley Park by tube. The rest of the party set off in groups to lose themselves in the whirl of London or to proceed direct to Wembley, explicit instructions being given as to getting back to Paddington in time for the return journey.

The End of a Perfect Day

At the end of the day the men were loud in their praises of the wonders of the Metropolis and the British Empire Exhibition, and full of gratitude to the company for enabling them to do the trip. Most of them visited the Palaces of Industry and Engineering, though disappointment was expressed that none of them had been successful in discovering a China Clay exhibit in the former. The arrangements proved very satisfactory and were carried out without a hitch, the party arriving at Paddington for the return journey in good time. In fact some, who were tired by their day's experiences, got to Paddington at 9 p.m. to wait for the train which started at 1 o'clock! The only casualty was a boy from Nanpean who fainted in the exhibition grounds from over-fatigue. Several others were almost "done up," but the majority were "game" to the last.

The return journey was made without any mishap or "missing," the first train arriving at St. Austell at 8 on Sunday, and the second half-an-hour later. Motors were waiting to convey the men to their homes in the clay district. All were agreed as to the success of the outing, and were loud in their praises of the way those in charge had looked to their welfare and made every effort to give them a good time.

Humorous Incidents

Before they started, some were hazy as to the real significance of the places they were told they would see when in London. One was very determined to visit Trafalgar Square because he had a picture of London's famous open space in his parlour, and when he came back he wanted to be able to point to the picture and say to his friends: "I've seen he." Among the places they were told they would see on their motor trip was Piccadilly Circus. "Be us," exclaimed one prospective tripper, "I thought we was going to see the Houses of Parliament, but I hadn't heard we was going to a circus."

Cornish pasties were much in evidence on the journey and on arrival in London. The London natives in the restaurants some of the party visited were astonished to see the men haul out their monster pasties and wondered what they were and whether their consumers would survive them.

A few in the train going up had no idea how far Wembley was and were tired of the journey before Plymouth was reached. One vowed that he would never undertake such a long journey again, and he had then only done about 30 miles of the 230 miles trip.

Londoners Surprised

Not the least interesting episode of the trip was the motor tour through London. As the procession of buses threaded its way through the crowded streets, the passers-by were soon made aware of the Cornish and Devon invasion, as they were greeted with cries of "How be 'ee"; "Have a parsty, Mister"; "Won't 'ee come along w' we?" On some Londoners raising their eyebrows at such familiarity they were enlightened by the explanation that "Us be up from Cornwall." "Ain't 'ee ever been back along"; "Come and have a dish o' tay," and other West-country expressions still further mystified the untravelled Londoners.

The traffic and traffic control were phases of the journey that aroused surprise mingled with admiration. When there was a jam their minds flew back to St. Austell, and several remarked that in one or two respects London was like St. Austell, and even better than at home on a market day. The moving electric light signs in London at night were objects of wonder to many of them, and after watching their liveliness for some time they left the problem of "how it was done" unsolved.

Adventure with Wembley Seats

At Wembley surprise followed surprise. Some entered into the spirit of the amusement park with zest, while others took their pleasures more soberly. Three clay-workers saw everything they could see for nothing, looked in at other people enjoying the fun of the amusement park, and then speculated 2d. apiece on chairs, the tickets being available until 6 o'clock when further tickets were required. When the ticket collector accosted them later in the evening they said, "We've got our tickets." On the collector informing them that they must have fresh tickets after 6 o'clock, one of them exclaimed, "Well, I'm blowed! they be after every penny 'ee 'ave, in 'ere."

Ceramic Society Meetings

The 14th meeting of the Refractory Materials section of the Ceramic Society will be held in Conference Hall No. 4, British Empire Exhibition, Wembley, London, on Thursday and Friday, September 18 and 19. Mr. Job. Holland will preside. Amongst the papers to be presented are the following:—"The Influence of Exposure on the Chemical and Physical Properties of Certain Fireclays" (Mr. W. Hughill, M.Met., and Mr. W. J. Rees, B.Sc., F.I.C.); "Alumina-Silica Minerals in Firebricks" (Mr. W. J. Rees, B.Sc.(Tech.), F.I.C.); "The Action of Heat on Kaolinite and other Clays," Part II (Mr. J. W. Mellor, D.Sc., and Mr. A. Scott, D.Sc.); "X-ray Investigation of Clays and other Ceramic Substances" (Mr. Assar Hadding, Sweden).

Tragic Death of Mr. Marshall Stocker

Killed While Inspecting China Clay Works

THE news of the untimely death of Mr. Wm. Marshall Grose Stocker, partner in the well-known firm of Messrs. Grose and Stocker, of Stoke-on-Trent and St. Austell; while inspecting Treskilling China Clay Works, near St. Austell, on September 2, caused a painful impression in China Clay circles.

Mr. Stocker arrived at Fowey Hotel the previous night, and in the morning was accompanied to the clay works by the firm's St. Austell manager, Mr. Thos. Martin, and by Mr. Joseph Dixon and his son, Mr. Oscar Dixon, of the well-known Grimsby and Sheffield paper-making firm of Messrs. Peter Dixon and Sons. On arriving at Treskilling, Mr. Stocker went straight to the bottoms, accompanied by Messrs. Dixon, Mr. Martin remaining on top. During the inspection of the bottoms Mr. Stocker and Mr. O. Dixon were making for the spot where the fatality occurred, when Mr. Dixon stopped for a moment to speak to the hose man, while Mr. Stocker went a few feet ahead. Almost immediately there was a fall of clay, which struck Mr. Stocker on the head, killing him instantly.

CAPT. MARSHALL STOCKER

Mr. Oscar Dixon's Narrow Escape

Mr. Oscar Dixon, of the paper-making firm of Peter Dixon and Sons, Grimsby and Sheffield, said he went with Mr. Stocker to the bottom of the pit, and on the way to the point where the fatality occurred witness stopped a minute or two to speak to the hose man. He saw Mr. Stocker stoop to pick up a sample of clay, and heard him say, " Look here, Oscar." Immediately after the virgin clay fell on him, striking him on the head. On going to him he found that deceased's temple was terribly bruised and bleeding, and he noticed that his tongue was swelling. They took him to a safer place and tried to keep up his circulation until the doctor arrived. Witness subsequently formed the opinion that he was killed on the spot. They had had no experience of similar falls of clay at the works.

Dr. Gilchrist, of St. Austell, said that when called death had taken place. He formed the opinion that deceased's neck was dislocated, causing instant death. He examined the fall of clay and found a hard lump, which probably caused the fatality.

A verdict that Mr. Stocker died from a dislocated neck caused by a fall of clay was returned.

The funeral took place at Astbury Church, Astbury, near Congleton, Cheshire, on September 6.

Mr. Stocker's War Service

Mr. Marshall Stocker, who was a bachelor, was one of three brothers and four sisters, children of the late Mr. Alexander Dingle Stocker, who was a cousin of the late Mr. Tom and Mr. Edward Stocker—fathers of Mr. T. Medland Stocker and Mr. Henry Stocker, of English China Clays, Ltd. His elder brother is Mr. A. D. Stanley Stocker, his other brother, Mr. Trelawney Stocker, being a solicitor at Stockport. His four sisters are Mrs. Briggs of Buxton, Mrs. Lovatt of Pipegate, Staffs., Mrs. Rosewarne Bradford of Bridgewater, and Mrs. Branston Bradford of Yeovil.

When the war broke out Mr. Marshall Stocker joined the 2nd Fifths North Staffordshire Regiment on its formation in 1914, and was one of the original officers. He served in France, later being on home service, was in Ireland with his regiment during the rebellion, and was demobilised while at Lincoln in 1919. He retired with the rank of captain. At Stoke-on-Trent, where Mr. Stocker lived, he was much respected and esteemed. He took a keen interest in the Boy Scout movement.

Widespread sympathy has been expressed with Mr. Stocker's firm and his relatives in their great loss.

The Funeral Ceremony

THE large number of sympathisers and the many beautiful floral tributes sent on the occasion of the funeral of Captain William Marshall Grose Stocker at Astbury Church, near Congleton, Cheshire, on September 6, testified to the respect and affection in which he was held. The service was characterised by an eloquent tribute to his character by his cousin, the Rev. Gladstone Sargent.

The interment took place amid many manifestations of sympathy from a representative gathering, which included several members of pottery and China Clay firms and bodies with which the deceased gentleman was prominently connected.

The body was brought from Cornwall to the residence of Captain Stocker's brother, Mr. A. D. S. Stocker, J.P., Heathfield, Congleton, and from here the cortege proceeded to the historic Astbury Church, where a service was held prior to the interment.

Potteries and China Clay Trade Represented

The greater number of those who came to pay their last tribute to one who was not only well known and highly respected among a wide circle of friends, but was loved by those with whom he came in contact, joined the mourners at the house, but many from the Potteries and others interested in China Clay firms went straight to the church. The cortege was a lengthy one, and the large number of wreaths and other floral tributes necessitated the use of four motor cars to convey these behind the hearse.

As the cortege reached the church gate it was met by the Rev. Gladstone Sargent, Vicar of St. Peter's, Highgate Hill, London (cousin of the late Captain Stocker), and the Rev. W. C. Lucy, Vicar of Astbury, who officiated at the service in the church and at the graveside. On entering the church, the organist (Mr. H. Smith) played " O rest in the Lord " (" Elijah "), and prior to the coffin being borne out of the church Chopin's Funeral March was played. The hymns chosen were " O God our Help in Ages Past " and " Peace, perfect Peace."

The chief mourners were Mr. A. D. S. Stocker, J.P. (brother), Mrs. Stocker (sister-in-law), Mr. G. L. T. Stocker (brother), Mrs. Arthur Briggs (sister), Mrs. W. M. Lovatt (sister), Mrs. Rosewarne Bradford (sister), Mrs. Branstone Bradford (sister), Major W. M. Lovatt (brother-in-law), Mr. F. M. Grose (cousin), Mr. Gregory King, Bristol (cousin), Rev. Gladstone Sargent (cousin), Mrs. G. Proctor (sister-in-law), Mr. George Proctor (Macclesfield), and Mr. A. Proctor (Macclesfield).

Representative Gathering

Amongst a large number of representative followers were Mr. E. Starkey, the Lancashire representative of Messrs. Grose and Stocker, and Mr. F. H. Wright, the Potteries representative; and from the clerical staff of Messrs. Grose and Stocker were Mr. B. Bailey, Mr. B. Challis, and Mr. H. Poole. Mr. T. Masters was also represented.

Present on behalf of the Stoke Amateur Swimming Club were Mr. E. Tracy, Mr. W. R. Dixon, Mr. E. C. Davies, Mr. G. McKenzie and Mr. W. Huxley.

The Hawkstone Park Golf Club were represented by the Rev. G. H. Grimes, Mr. M. Cutler, and Mr. A. G. Sheppard.

Representing the N.S. Battalion Boys' Brigade were Captain J. H. Greenwood, Captain J. L. Johnson, Captain J. Hill, and Captain W. G. Fox. The 4th N.S. (Stoke) Company were represented by Captain C. J. Deaville, the Rev. J.

Sadler Reece (captain), Lieut. R. Burt, Lieut. C. Cartlidge, Lieut. C. Findler, Lieut. L. Turner, Lieut. C. Hartherne, Lieut. C. H. Butler, Bandmaster J. Haines, Sergeants W. Mansfield, S. Turner, S. Foster, L. Deaville, and S. Tomlinson; Corporals A. Pitchford and N. Hill, and Privates S. Hughes, A. Chivers and E. Turner.

Representing the old boys of the 4th Company were Mr. W. Dickson, Mr. B. Davies, Mr. M. Copestake, Mr. G. Walklett, Mr. F. Hewitt, Mr. F. Slater and Mr. W. Newman.

Among those present at the church were the Mayor of Stoke-on-Trent (Alderman F. Collis), Mr. E. Marshall (Messrs. Fitton and Stocker, Manchester), Mr. T. Wolstenhome (Messrs. Fitton and Stocker), Mr. R. T. Longden, Master J. A. T. Longden, Mrs. Longden, Mr. Stewart Johnson, Mr. F. Huntback, Mr. A. R. Piercy, Mr. R. W. Varcoe (representing Messrs. Varcoes China Clays, Ltd.), Mr. H. Eagland (representing Messrs. English China Clays, Ltd.), Dr. G. H. Williams, Mr. F. D. Boulton, and Mr. J. G. Shorter (Alsager).

An Appreciation

A very fitting tribute to the deceased gentleman was paid by the Rev. Gladstone Sargent, who said: "It does us good in times like these to think a bit about him whom we mourn, and to remember something of what he was to so many—I suppose to all those who are present this morning at this service. There is probably no one who is less fitted than I am, by personal experience at any rate, to pay any worthy tribute to him whose sudden and tragic death we mourn and to whom we pay our last respects; and yet it is my privilege to say something of the high esteem and warm affection in which he was so universally held. I do this on the testimony of many witnesses.

"William Marshall Grose Stocker was a man whose noble character and kindly heart made him popular wherever he went, among people of all ages and among every walk in life. No higher tribute can be paid to any man than to say that children loved him, for the child's heart is intuitively attracted by all that is best in human nature. His keen interest in, and his invaluable service for, the Boys' Brigade bears witness to his love for the young and his earnest desire for their highest welfare. In the social circle and among his business acquaintances he was not only admired but loved, and in his regiment during the war he won something deeper than mere devotion both from his fellow officers and from his men. It would be difficult to enumerate the various qualities which united to make him so much beloved by all who knew him, but the words which seem to be on everyone's lips about him sum up all the characteristics, 'He was the best of friends.' He possessed a great capacity for friendship. It has been said of him that into whatever company of people he entered, for however short a time, he left his mark upon them, for he radiated a spirit of happiness and goodwill. Nor was his influence merely passive. He was a friend who ever sought to help others actively. His kindly advice, his generous gifts, his helping hand were ever ready to do good. What more noble and real Christian qualities could a man possess than these?

"We mourn his loss with a large company of those who counted him their friend, but there is one whose loss is greatest of all—one to whom he was indeed, as Jonathan was to David, a brother, not only in the flesh but in the spirit. He was not only the best of friends, but the best of brothers. It is always difficult to see why such a life should be cut short, but we lay our brother to rest knowing that in a comparatively short life he has accomplished far more than many a world-famous man has done.

"Marshall lives! His life is not cut short, but is raised to an infinitely higher level; his service has not ceased, but has begun again and afresh in another realm. May Christ give to us, and to those who mourn so deeply, not only the spirit of resignation and perfect peace, but something even more and greater than that—something of the spirit of triumph."

The coffin was of plain oak and bore the following inscription: "William Marshall Grose Stocker, died 2nd September, 1924, aged 49 years." The grave was lined with ferns, roses and chrysanthemums.

The bearers were six "old boys" from the 6th Company Boys' Brigade.

There were many floral tributes both from the family and from a large number of friends and employees.

China Clay Producers

Sudden Collapse of Association

AT an urgently-called meeting of Associated China Clays, Ltd.—the association that has conserved the interests of the industry as a whole since its formation in 1918—at St. Austell on September 11, a momentous decision was arrived at which resulted in the break-up of the Association, leading to the immediate cessation of its functions.

In order to safeguard the best interests of the trade during the continued trade depression and the abnormal conditions prevailing, it was decided by the producers at the beginning of 1923 to continue the Association, and accordingly a new constitution was agreed to and entered into by producers, who agreed to stand by the conditions contained therein. In March this year a crisis arose through certain firms putting forward claims which, if conceded, would have undermined the constitution of the Association and violated the principle of equality upon which it was based. When it was pointed out to these firms that their insistence on special treatment would involve the break-up of the Association, they withdrew their demands.

A Quickly Developed Crisis

A fresh crisis arose early in September through one of the firms which were concerned in the former crisis again putting forward special demands which could not be conceded. The firm in question then intimated that they were withdrawing from the Association, as a consequence of which a special meeting was convened at once.

Prior to the general meeting of producers, a board meeting of the Association was held at which opinion was much divided as to whether or not the Association should continue to function, the representatives of the largest firms favouring the taking up of the challenge thrown down by the firm in question and disbanding the Association. On a motion favouring winding up being put to the vote, 13 voted for, six against, and four remained neutral.

Much concern prevailed among the majority of the producers as to the effect of such a decision if confirmed, when the result of the board meeting was communicated to them.

The Hon. H. D. McLaren presided, and explained that there were the three following courses open to them:

1. To continue the Association without the seceding firm.
2. To insist by legal action on the observance of the agreement which the seceding firm, in common with the other members of the Association, had entered into.
3. To disband the Association.

Some of the big producers were not prepared to adopt the first course, the second course was open to the objection that it would involve prolonged litigation, while the third would leave every producer open to ignore the rules of the Association, as the seceding firm had done.

Serious Discussion

The discussion ensued for an hour and a half, the producers reviewing the crisis from every standpoint. The smaller producers made every effort to persuade the Big Three (English China Clays, Ltd.; J. Lovering and Co.; and H. D. Pochin and Co., Ltd.) to allow the matter to be postponed with a view to steps being taken to maintain the *status quo*. The big producers, however, replied that the repeated attempts to neutralise the advantages of the Association by certain producers demanding special concessions had forced their patience to the limit, and rather than leave themselves open any longer to that form of attack, they would meet competition in the open.

The result of the tonnage vote insisted upon was as follows: Total voting strength, 8,309; in favour of winding up, 6,232; against winding up, 1,692; majority, 4,540. This being more than the requisite number under the constitution, producers are no longer under any obligation to observe standard prices, and the Association ceased to operate after September 12.

What the effect on the industry as a whole will be it is difficult at present to judge, but that any reduction in prices from those previously ruling under the Association will hit some firms severely is certain, because the Association's prices were fixed at a level so as to ensure only a reasonable profit and the payment of a living wage to the largest number of men.

Alum and Alum Cake

How They are Produced from China Clay

For many years alum and alum cake have been extensively made from an artificial sulphate of alumina, prepared from China Clay. Some details of the manner in which it was originally produced are given below. Improvements have been introduced in the methods of producing alum and alum cake, but the main active principles of their manufacture have altered comparatively little.

Sulphate of Alumina Patents

In 1857, a patentee called Norris patented a process for the manufacture of sulphate of alumina from China Clay. "Take China Clay and mix it with the same quantity of sulphuric acid, moderately hot, from the usual evaporating boiler. Either of the materials may be used cold, provided the other be sufficiently hot. Put the mixture into a heap of any convenient size, and the action of the acid on the clay commences spontaneously, proceeding with violent rapidity until the heap becomes a dry, crude sulphate of alumina, and when cold is fit for sale."

In the same year a patent was granted to D. Baker for the manufacture of compounds of alumina from China Clay. "Take the liquor obtained from alum rock by the application of sulphuric acid, evaporated to about 95° Twad., and stir in a quantity of China Clay in a state of powder, so as intimately to mix the compounds." The quantity of clay used is about one part of clay to nineteen parts of the liquor. After about from ten to fifteen minutes the whole is run off to solidify, the stirring being continued as long as it can be done. The compound thus produced may be used as a substitute for alum and other aluminous compounds where great purity is not necessary.

In 1861, A. A. Croll obtained a patent for the manufacture of sulphate of alumina from China Clay. After the clay has been roasted and powdered, it is heated again till it has attained a temperature of 300° Fahr. Sulphuric acid of 300° Fahr. and 1·7 strength is then caused to flow upon it in the proportion of weight for weight of aluminous matter. The whole must then be intimately mixed, and crude sulphate of alumina is the result.

In 1862, a patent was granted to Alfred Noble for obtaining compounds of alumina from China Clay. The clay is calcined at a low red heat and exposed to the action of hydrochloric acid gas, of a temperature of about 200° Fahr. If the temperature is higher than this, no action will take place, and if too low, the compound will be partly liquefied. When the operation has been successfully performed, crude chloralum in a dry state is the resulting substance. This may be purified from free acid by heating it for some time, exposed to a current of air. This drives off the hydrochloric acid, and decomposes any chloride of iron that may be present. The mass is then heated with water, and the silica and oxide of iron removed by filtration. In this way an almost pure chloride of aluminium is obtained, suitable for the use of the dyer, paper maker, and for other purposes for which alum is employed.

How the China Clay is Treated

We give below a comprehensive description of the process embodying the salient features of the production of alum products from China Clay. Before being treated for the production of the sulphate of alumina, the China Clay has to be calcined to expel the moisture and peroxidise any iron it contains. The peroxidation of the iron renders it less soluble in the sulphuric acid, and the silica of the clay, by reacting on the alumina, imparts its aggregation and makes it more readily attracted by the acid. The expulsion of the water renders the clay porous and capable of absorbing the sulphuric acid by capillary attraction.

The clay should therefore be moderately calcined, but not so as to indurate it like pottery ware, for certain combinations would then be effected which would make it resist the action of acids. The clay is usually calcined in a reverberatory furnace, the flame of which serves afterwards to heat two evaporating pans and a basin for containing a mixture of the calcined clay and sulphuric acid. As soon as the clay becomes friable in the furnace, it is taken out, reduced to powder, and passed through a fine sieve. With 100 parts of the pulverised clay, 45 parts of sulphuric acid, of specific gravity 1·45, are well mixed in a stone basin arched over with brickwork. The flame and hot air of the reverberatory furnace are made to play along the mixture. The mixture being stirred from time to time is, at the end of a few days, to be raked out and to be set aside in a warm place, for the acid to work on the clay, during six or eight weeks. At the end of this time it must be washed, to extract the sulphate of alumina.

With this in view, it may be treated in the ordinary way of roasted alum. If potash alum is to be formed this sulphate of alumina is evaporated to the specific gravity of 1·38, but if ammonia alum, to the specific gravity of only 1·24 because the sulphate of ammonia, being soluble in twice its weight of water, will cause a precipitation of pulverulent alum from a weaker solution of sulphate of alumina than the less soluble sulphate of potash could do.

Alum Cake

This substance owes its value to the amount of sulphate of alumina it contains. To prepare it very fine China Clay is used, free from iron. It is heated in a furnace, mixed thoroughly with acid, and if carefully managed the combination of the alumina and sulphuric acid is not only complete, but so violent that to calm the action it is necessary considerably to dilute the acid.

When mixed it is passed into cisterns with movable sides, where in a few minutes it heats violently and boils. The thick liquid gradually becomes thicker, until it is converted into a solid porous mass, the pores being made by the bubbles of steam which rise in the mass, which is not fluid enough to contract to its original volume. The porous mass is perfectly dry, although containing a large amount of combined water. It retains, of course, all the silica of the original clay, but this is in such fine division that every particle appears homogeneous.

The Filter Press

(From a Correspondent.)

The filter press has been working for more than a decade at Drinniek Mill and Hendra Clay Drys (E.C.C., Ltd.), giving great satisfaction in coal-saving and especially in the case of rush cargoes, because it is possible to dry three times the quantity over any given kiln area than can be dried without them.

This is a great advantage both to the clay company and also to buyers who may be in urgent need of any particular brand of clay. In all these presses the clay in solution is pumped from the settling tanks into the press by a ram-plunger-pump, the pump stopped or diverted to another press when it is full, and it has then to be opened and emptied by hand. We understand Mr. T. M. Stocker has recently been experimenting with an improved press for making a continuous cake, thus obviating the necessity of opening the press to empty it. Meanwhile, Mr. Alfred Davies, manager of E.C.C., Ltd., ably backed by his chief, Mr. R. Martyn, managing director, has achieved a notable success at Melbur by installing a *gravitational* press, where the clay goes straight from the cone-shaped pits through steel pipes into the press, and without any mechanical power by its own fall (Melbur claypit being on the side of a hill) it makes as good if not a better "cake" than the presses worked with hydraulic rams.

This press does *not* require an engine to fill it—it fills itself! Consequently there are no coal or oil bills to pay.

Further, for even a very large kiln it only needs just one tank to catch the slight outflow, thus effecting another great saving when building a clay-drying plant. We understand that Mr. Davies experimented with small-bore pipes and a Baby-sample press before he started to lay down the big 100-plate one. Mr. Davies found that it made a solid cake at a certain pressure, and knowing that he had "head" enough at Melbur to produce a similar pressure per sq. inch and feeling confident of the ultimate success of his plan he went ahead. Mr. Davies being once assured that his idea is founded on right principles and can be turned into a commercial success there are few people more diligent and expeditious in carrying a scheme through. For example, this particular press—though there were peculiar difficulties about the design of it which needed altering before it was suitable for clay-pressing—was laid down and working (enabling the firm to execute

(*Continued on page* 14)

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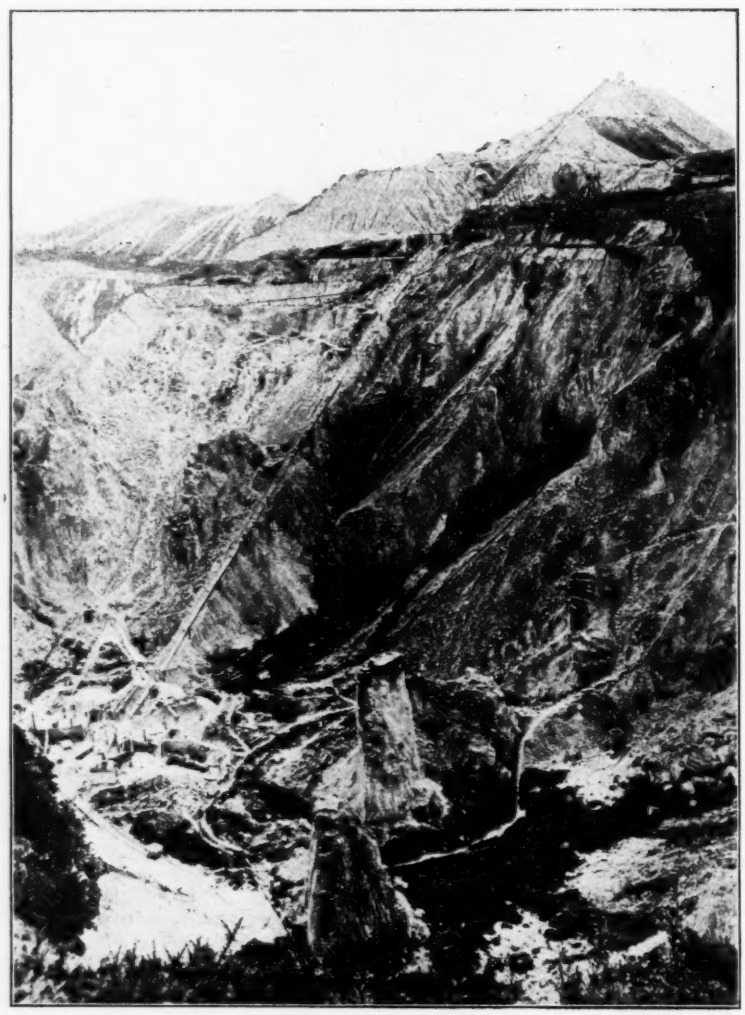

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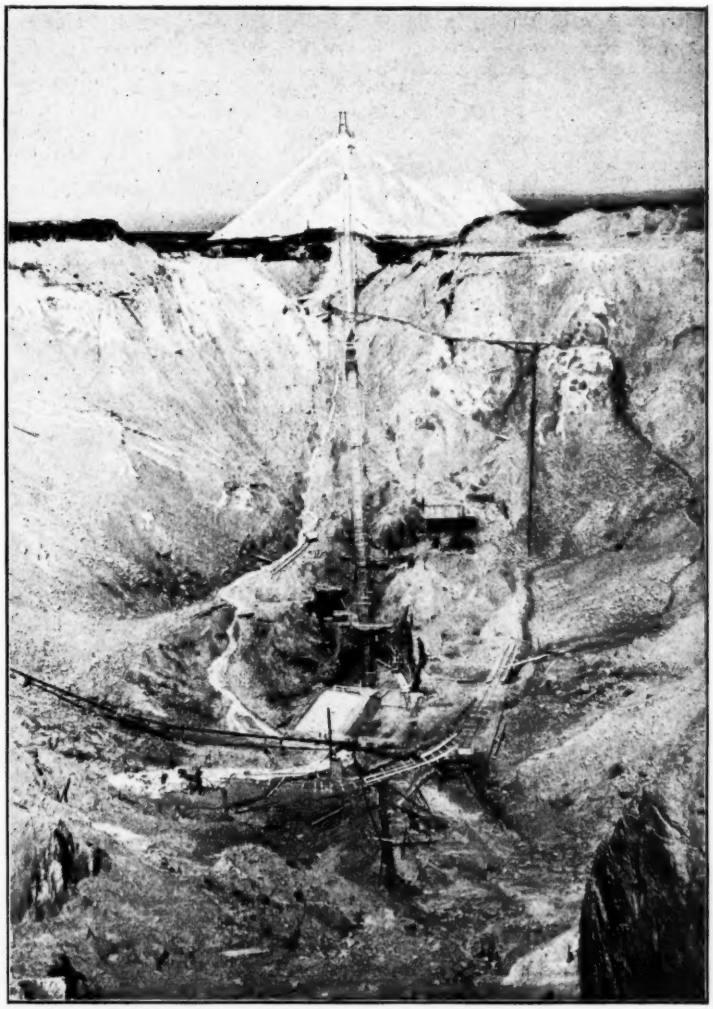

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(*Continued from page* 11)

orders running into thousands of tons) while some people would be still discussing plans. We hear he is still experimenting on a larger cake and has been successful in getting one over 600 lbs. weight. Should this prove practical it will result in a saving of press-cloths and also in time saved by too frequent opening of the press.

In connection with the above there is also a modernised, up-to-date air-drying shed with special shelves and louvres. This is combining the earliest with the very latest method of drying clay and should be of interest to buyers as the clay will retain the valuable properties claimed by the old air-dried clays, as the " vitamines," so to speak, will not be steamed out of it. We congratulate English China Clays on their management ; for years they have led the van of progress as regards the application of new scientific principles to China Clay producing with the view of making it better for all concerned, labour-saving and fuel-saving devices, new methods for expeditiously and economically removing sand and overburthen, also improvements in refining and drying their numerous grades of clay.

China Clay as Refining Agent

Its Use in Softening Water and Purifying Sewage

In various ways China Clay is employed as a water softener both for domestic and industrial purposes. Its softening qualities are evident in the natural water supplies of Cornwall and Devon, which have a soft, velvety nature and do not require so much soap for smooth personal ablutions such as is necessary to minimise the harshness of the water of other places. It is the softness of the water of Cornwall and Devon that imparts the remarkaole freshness to the complexions of the natives, especially the fair sex, in the West of England so much admired by " foreigners."

The softening of water for industrial purposes, no less than for domestic, is a phase of industrial chemistry that has developed of late years, especially in its application to water used for domestic and commercial purposes. A softened water lessens the corrosive action on the interior of boilers and also minimises acid deterioration in that and other directions.

China Clay plays an important part in the " Permutit " water-softening process, which has a great vogue in Canada and America and is being increasingly adopted in this country. The process is based on a selective action possessed to a small degree by all chemical compounds, and which is very strongly marked in a few. In them chemical changes are affected by the relative solubilities of these chemicals. A few natural minerals of this class are known as zeolites, and are similar to the artificial permutit, which has the following composition : 2 SiO (silicic acid), AlO (alumina), a loosely-held base, and six molecules of water. Let it be assumed that the loose base is soda, sodium oxide, then, if a solution of a calcium salt—for instance, bi-carbonate of lime—be passed through the permutit, the sodium oxide is exchanged for the calcium oxide, the former combining with the carbonic acid to form bi-carbonate of soda. If now we pass a solution of common salt (chloride of sodium, NaCl) through the changed permutit, it parts with its calcium, and again takes up sodium. But this second reaction takes place the more readily the greater the relative strength of the dissolved sodium salt to the dissolved calcium salt. This means that whereas sodium permutit will extract all the calcium out of a solution with which it is brought in contact, calcium permutit will not act in the reverse sense and extract all soda from its solution, unless the solution is practically free from calcium salts. This means that the salt solution with which the permutit is regenerated ought to be as pure as possible. Thus, for instance, the output of a permutit softener is nearly doubled by using pure salts instead of rock salt, or natural brine.

Softening Process at Work

The softening procedure consists in passing the hard (lime) water through the permutit, whereby all the hardness is readily removed, and then indulging in a regenerating process by passing an excess of a solution of common salt through the permutit. It is, therefore, evident that more salt must be used than the equivalent of the lime contained in the untreated water. It also follows that the treated water will contain an equivalent amount of sodium bicarbonate or sulphate, as the case may be, for the amount of lime removed. This process removes all the lime and can produce a water which is perfectly soft and suitable for almost any washing and dyeing process. The process is sometimes modified in practice by first reducing the hardness of the natural water to a few degrees by the ordinary lime and carbonate of soda process, and then treating it with permutit. About 5 per cent. of permutit is lost per annum, due to the purifying and regenerating operations. The speed with which the feed water is passed through permutit should not exceed 12 ft. to 15 ft. per hour. This speed fixes the diameters of the permutit tanks.

For Domestic Purposes

This water softener appeals particularly to people who live in country houses where the water supply is not of the best, this water-softening process doing away with the old-fashioned rain-tubs and storage tanks. The principle, stated in non-technical language, is this :

The water passes through a filter plant containing the product obtained by smelting a mixture of silica, alumina, china clay, and sodium of calcium, and flows out beautifully soft and clean. The filter requires no more attention than an occasional "regeneration" with a salt solution, which automatically pours through the filter from a tank fitted above.

A miniature plant is made for toilet purposes which, by taking all the hardness out of the water, effects a great economy in the consumption of soap, while another plant for the table gives water said to be as wholesome as the popular table waters.

For Commercial Purposes

The plant used for commercial purposes is designed to do away with the corrosion of boilers and tubes where the water contains elements that produce this trouble, and is also used for the softening of water required in certain manufactures where water containing impurities and corrosive action are detrimental.

Testimony to the success of the materials used in the permutit process has been forthcoming from firms who use boilers. They state that, whereas they formerly encountered continual trouble with scale and sludge in their boilers, necessitating men being kept employed cleaning and repairing them frequently, since the use of water-softening processes not a bit of scale has collected in the boilers, while the consumption of coal was reduced in one case by 25 per cent. One firm has vouchsafed the information that new tubes put in the boilers two or three years ago have been kept as bright and clean as when they were put in. Their boilers are opened now only for inspection.

Sewage Purifying Process

A good deal of interest has been evoked by our recent article on the use of China Clay in conjunction with other materials in the filtration of water and sewage. In the purification of water for domestic purposes it is used either in the filter bed or at an intervening point between the source and the point of distribution.

As regards the inland treatment of sewage on the septic tank system, purifying material manufactured by one big firm of chemical manufacturers has been a composition of sulphuric acid, soot, and China Clay. In some tank sewage systems it may be possible to lay them out in such a way as to dispense with the filter beds and rely entirely upon the treatment in the chemical tanks, this, of course, depending upon the quantity and character of the sewage treated and the strength of the chemical composition.

As to the proportion of the ingredients forming the deodoriser, this depends somewhat upon circumstances, but when the formula was disclosed to the present writer he was not told in what proportions the composition contained sulphuric acid, soot, and China Clay. The right proportions are easily ascertainable by experiment. The manner of its employment is in tanks into which the sewage flows before it passes on to the filter beds, which usually comprise coke breeze, clinkers, and sand. The chemical tank acts upon sewage as a deodoriser and disinfectant, eliminating the fœtid odour and dispersing the bulk of the deleterious matter, so that the resultant affluent passes on to the filter beds in a comparatively innocuous state.

The Kaolin Deposits of Furtei, Sardinia

Quality and Analysis of China Clay Deposits

One of the most striking features in Sardinian morphology and geology is found in the strip of land formed by the plain of Campidano which runs, almost without a break, from Sassari to Oristano and Cagliari, dividing the island into two parts by a marked depression. The western, more ample and massive, comprising the highest point of the Genargentu chain of mountains, runs from the Bocche di Bonifacio to Capo Carbonaro. The eastern side, on the other hand, is cut into two smaller parts, viz., Nurra, which forms the N.W. district of the island, and Suleis-Iglesiente, forming the S.W. district. This division is especially distinct in the southern half, where the extensive and regular plain, between Oristano and Cagliari, formed of quaternary sediment and recently left bare by the sea, might be compared to a large corridor walled in by two almost continuous chains of mountains. Very probably this corridor is, to a certain extent, formed by two lines of fracture, almost parallel, bounding a deep place, as demonstrated by the fact that the plain of Campidano has a chain of volcanoes on either side, the alignment of which is remarkably clear and evident.

The volcanic group of Furtei-Serrenti forms part of the eastern chain to which, in the south, the Monastir group belongs, not far from the miocene hills of Cagliari, as also do, in the N.W., the volcanoes of S. Gavino Monreale and the big Monte Arci, close to the Campidano plain of Oristano.

There are no modern observations respecting these volcanoes, except some petrographic analyses of lava from Monte Arci made by Washington. Consequently a contribution to their description, however humble and restricted, will not be without utility.

The volcanic region with which we shall deal lies between Serrenti in the south and Furtei and Segarin in the north, covering a roughly elliptic and elongated area from N.W. to S.W., with a greater diameter of 7 to 8 kilometres and a lesser diameter of 4 to 5, at a distance of about 40 kilometres from Cagliari. There is a multitude of cones varying in altitude from tens to hundreds of metres, culminating in Mount Coronas Arrubias, 374 metres high, and comprising amongst the highest points, Monte S. Miali, 336 metres; Punta Sebera, 360; Monte Maiori, 340; Monte Tellura, 313.

Although exogenic influences may have modified the primitive aspect of the country, the landscape is yet very characteristic both owing to the shape of the larger cones and the numerous smaller ones formed upon them. Thus no one gazing on the country even from a distance can doubt about its nature and origin.

Examination, even very superficial, of the Furtei volcanoes, as specially made by Professor E. Repossi on the western side, demonstrates that the structure is not very simple and there are at least two different petrographic formations: one of great length and more abundant which perfectly resembles, in some instances, certain volcanic rocks of Siliqua (on the Cagliari-Iglesias road studied by Bertolio and described as trachytic andesite), and another like basalt with the typical knotty formation of the basalt so common in Sardinia. There are also brecciated and tufaceous types, some fine specimens being found on the south slope of Monte Craboni. A geological and petrographic study of this group, which certainly requires time, can be made later, the following lines being devoted to a description of the extensive kaolin formation therein existing.

Vast Kaolin Deposits

The kaolin of Serrenti is spoken of by La Marmora in his book entitled "Voyage en Sardaigne," as also by later writers. However, all that has been hitherto noted in scientific works does not, according to Professor E. Repossi, give an idea of the vastness of the kaolin formation in the volcanic region in question. The large openings of the pits, the whiteness of which is conspicuous at a distance, already tell the observer that he is in presence of a very vast deposit. There is a group of them above Serrenti, on the west side of Monte Perceddu, and then another near the summit of Monte Coronas Arrubias, and a third in the valley south of Monte Craboni.

These three groups of kaolin pits lie more or less on the circumference of the volcanic locality, and it may be said that the places where the rock is kaolinised to a greater or less degree form an almost unbroken cluster around the locality in question, a fact regarded as not without significance in making a hypothesis on the origin of kaolinisation, specially noted by Professor E. Repossi at Monte Craboni, Monte Cresia, Amigu, Furoni, Brunen Antoni Allea, and Costa sa Tiria, forming part of the Monte S. Miali group, in the territory of Furtei. This kaolinisation, varying in degree but always distinct from the usual surface decomposition, is uniformly distributed throughout the region. The fresh, or apparently fresh rock, because it was noted everywhere in Sardinia that there is often deep decomposition of the rocks without any great corresponding change in the exterior aspect, has a rather dark tint, violet brown or grey, always with a markedly porphyric structure. The occluded rock, sometimes of considerable dimensions, is generally felspar, which, as at Siliqua, seems exclusively ascribable to a somewhat acid plagioclase and basaltic hornblende. Biotite is less abundant and quartz scarce. The fundamental paste, usually completely crystallised and in which there is probably a certain amount of sanïdin, is compact and uniform.

Near the most eastern of the pits visited there are less markedly porphyric formations owing to the much smaller dimensions of the occluded mineral, with a trachytic aspect, containing such quantities of angular fragments of the most usual type as to give a clearly brecciated aspect.

In the same locality there are also tufaceous beds. Superficial decomposition, which however runs to some depth so that the excavations made in prospecting do not show a really sound rock anywhere, is demonstrated by a rather marked discoloration of the rock which is not usually associated with a conspicuous tendency to turn yellow, and naturally with great loss of cohesion. This decomposition is found everywhere and has no special feature.

Distinct Kaolinic Decomposition

On the other hand, kaolinic decomposition is clearly localised and distinct. It can, however, be recognised simply by breaking the rock with a hammer.

On the borders of the numerous fractures running through the rock in all directions there are signs of incipient kaolinisation, so much so that in some cases the surface appears to be covered with a net-work of white bands limiting the angular area in which the rock retains its ordinary grey or brown grey colour.

In places, however, where kaolinisation is more advanced all the rock has a milk white or yellowish white or even greenish white colour, characteristic and evenly distributed. Finally, it has that softness which is usually met with in similar formations. Even in cases where kaolinisation is more advanced or complete, there are always bands, sometimes of considerable thickness, of very white and uniform pulverulent kaolin. One might almost say that this kaolin was carried and deposited by water, filling the crevices. This fact seems constant and significant. It can also be stated that where the rock is kaolinised there are always fractures, and kaolinisation seems more complete in places where the network of fractures, with more or less large meshes, is more regular and abundant. In some of the kaolin pits this phenomenon is strikingly conspicuous. Sometimes another fact can be noted in the more superficial part of the kaolinised mass, viz., that a network, with meshes of considerable dimensions, of capillary fissures in which very thin films of sediment were deposited, runs over these masses. In such cases the felled rock which naturally cleaves along the fissures has an appearance which is anything but reassuring from the practical point of view, all the fragments being coated with limonite. When, however, the surface is scraped the coating is found to be very thin and underneath white kaolin is found. It was previously stated that the kaolinised zone is very extensive and almost continuous. It must, however, be noted that even between the most decomposed areas there are strips and spots where kaolinisation is less marked or almost entirely absent. These places correspond with the points at which the fissures seem to disappear.

It is also to be noted, and experience in industry confirms this, that the brecciated rock or, better still, the tufaceous

rock, which is more porous, is much more perfectly kaolinised than elsewhere and the kaolin is porous and almost soft.

Another fact brought to light by excavating is that kaolinisation increases everywhere with depth and in some instances penetrates underneath surfaces on which only the usual superficial decomposition exists.

Quality Improves with Depth

In fact, as the depth of the pits is increased in the most favourable places, the kaolin becomes purer and whiter, it having also been practically demonstrated that quality, from the industrial point of view, improves with depth. This fact was also noted in the Scano pit in which the working place is not less than 15 metres high. In this large pit, which cuts through the rock with a width of not less than 45 metres, the kaolinised parts grow more intense with depth and are more marked along certain fractures which, to judge from the thickness of very white pulverulent kaolin, were apparently originally of considerable width.

At the Cugusi pits the first traces of kaolinic decomposition are met with starting at the little domes on the border of the plain (Brunneu su Murdegu), where, as previously stated, the kaolin is in thin bands forming a network between the rock.

Then entering the vale of Ria sa Perdala the various excavations on either side of the same valley demonstrate that here kaolinisation is widely diffused, almost everywhere, on an explored distance of not less than one kilometre. The numerous pits are all on the right side of the valley. The Cava pit, which is the highest and actually the furthest inside the valley, is perhaps that in which kaolinisation is most complete. The rock has a typically brecciated aspect and, although kaolinisation is perfect, brecciation is conspicuous on the working place and the kaolin shows slight changes in colour according to the primitive rock constituting the fragments of the breccia. In this pit there are fine specimens of completely pseudo-morphosed kaolin on large occluded felspar and hornblend crystals enclosed in a rough porphyric surface of the rock. The pseudo-morphs on the hornblend are particularly fine and can easily be separated. More to the west and a little below this pit there are two larger ones in which the aspect of the formation is not much different. Here, however, the primitive rock seems to have been entirely tufaceous.

Somewhat lower down, still going west along the valley, beyond a relatively wide tract where kaolinisation is incomplete or totally absent, there is the larger group of pits of this chain, amongst them being that already mentioned, viz., Scano.

An extensive working place has been opened out in this pit which clearly shows the trend and characteristics of the phenomenon now in question. Here, amongst other places, it has been found that whilst a superficial examination gives the impression that kaolinisation is in all parts to the same degree, analysis demonstrates, as also do practical tests, that in some places there are great differences, so that the production of the pit comprises a certain percentage of waste. In any case this group of pits, which has produced considerable quantities of kaolin and will be able to produce large quantities later, is really very extensive. Other pits, like the Sprone, which seem to have had completely tufaceous primitive strata, are yet lower down near the mouth of the little valley in the open plain.

In these pits, as also in the group comprising the Scano pit, this aforementioned infiltration of limonite into the crevices met with in the kaolin formation is somewhat frequent and apparently of superficial origin.

Interesting Analyses

Hitherto there have only been industrial analyses of the kaolin from these pits, made with the raw material. Some, however, made by Professor F. Giolitti for the Ansaldo Co., who utilise large quantities of Furtei kaolin to manufacture refractory materials for the furnaces of steel works, are not without scientific interest.

According to these analyses the kaolin from the various pits is practically free from alkali, lime, and magnesia. Iron oxide, in form of ferric oxide in the calcined clay, is never more than 1·85 per cent., and usually only exists in traces; silica, always in the calcined clay, varies from 57 to 68 per cent.; alumina, 30 to 43 per cent. The loss at red heat is 5 to 7·5 per cent. Without dwelling further on these analyses, interesting from different points of view, reserving their study until there are more complete analyses made on a different basis, it may now be concluded that, at least in most cases, decomposition of the primitive rock, presumably rich in alkali and certainly not without perceptible percentages of lime and magnesia, was really profound.

From the industrial point of view—viz., manufacture of refractory products—it must be noted that this kaolin is deserving of all consideration, the more so as hitherto the pits have been worked without judgment and by persons yet little acquainted with kaolin itself.

Some quarries of this group will perhaps in future be worked solely for refractory materials; but the best, especially the Cava pit, will be able to supply kaolin suitable for more artistic applications, especially if the clay is properly prepared and mixed with a somewhat fatter kaolin.

The Furtei pits were only opened in 1917, and during the years of working prior to the present industrial crisis their production was 10,000 metric tons, and now at least the same quantity is ready in the yards.

Industrial Possibilities

Examination of the various pits and the numerous excavations made in their vicinity gives one the impression that, within their area alone, there are many thousands of tons similar to those already extracted. These figures, says Professor E. Repossi, given as a practical basis for comparison, furnish an idea of the industrial importance of this deposit, but are far from perfectly showing the vastness of the formation upon which he has so often dwelt. What can be said of the other group of pits in the same region which he very hurriedly examined? White spots are visible in the pits of Cuccuru Cabriolus and Coronas Arrubias in Segariu. All these pits have had, and to some extent still have, a considerable production, and a new and lasting revival is expected at all points of the vast deposit.

The formation briefly described, however, seems interesting even from a purely scientific point of view.

We can note how complex is the problem of argillous and kaolinic decomposition of igneous rocks. It is now generally considered that formation of crystalline kaolin, or kaolin strictly so called, followed remarkably violent disturbances such as the hydrothermal or pneumo-hydatogenic actions usually accompanying eruptive paroxysms. The ordinary weathering effects in our climates would simply produce argillous hydrogels consequently, never crystalline, and quite different. The question, however, is not finally solved.

From what has been said concerning the Furtei-Serrenti deposit it follows that here we are confronted with two perfectly different kinds of decomposition of the primitive trachytic rock—one superficial and universal, and the other within the soil and apparently greater with depth, restricted to very distinct spots in such a way as to form a rough circumference around all the volcanic group.

In the second place, the kaolinised places both superficial and below ground, at least where it was possible to observe them, seem to follow lines and zones of fracture in the rocks which it is reasonable to suppose, from their position, are distinct from the general system of fissures caused by exogenic physical causes.

There are no known thermal springs in the region or other manifestations, even remote, of endogenic activity which can be regarded as the final traces of the quaternary eruptive cycle which produced the volcanoes of Furtei, such as those found in the not distant Sardara. It seems, however, that all the conditions now specified are not only at variance with current opinion on the origin of kaolin, but even support it and give a significant proof.

The impression given by examination of these fractures is that they were primitively the outlets for springs and emanations which, by acting on the rocks, caused decomposition. Their penetration into the soil and circumferential arrangement with regard to the volcanic region are quite conformable with what is usually found in similar post-volcanic phenomena. Though there are no thermal springs nor emanations at Furtei now, there is every reason to suppose that they existed formerly at a period nearer the time of violent eruptions.

Rassegna Mineraria, July 15, 1924.

China Clay Notes and News

China Clay Works Sold

There was a large attendance of China Clay producers and merchants at St. Austell on September 4, when Mr. A. G. Watkins offered for sale by auction Treskilling China Clay Works and Bridges Moor Mica China Clay Works, with dries, plant, and machinery capable of producing 18,000 to 20,000 tons of China Clay and 3,000 tons of mica clay per annum, with siding accommodation on the Great Western Railway line at Luxulyan, on the Newquay branch. The total minimum rents are £480, and the royalties from 9d. to 2s. per ton, according to price. The landowners jointly interested in the properties are Viscount Clifden, Messrs. Gill and Ivimey, Duchy of Cornwall, the Martyn Estate, and Mr. J. C. S. Rashleigh. The properties were sold to Messrs. Peter Dixon and Sons, papermakers, of Grimsby and Sheffield, for £13,000. Messrs. Le Brasseur and Oakley, of London, acted as solicitors for the vendors. The starting bids were £3,000 by Mr. E. J. Hancock and £5,000 by Mr. John Hooper, who are both interested in other China Clay properties.

Before commencing the sale the auctioneer referred sympathetically to the tragic death of Mr. Marshall Stocker at the works the previous Tuesday, and expressed on behalf of the China Clay trade sympathy with his firm and relatives.

New American China Clay Port

The New York Times announces that for the first time in the history of Indiana Lake commerce, a vessel coming straight from a European port docked at Michigan City a fortnight ago. She was the steamship *Agga*, which left Cornwall on July 22, from Fowey, loaded with bulk China Clay. The American representative of the English China Clay industry expressed himself as hopeful of establishing a regular line of such ships.

Clay Workers' Partiality for Bands

What singing and choirs are to the Welsh, and whippet racing to the coal miners, bands are to the China Clay workers of Cornwall, for within a radius of Clayopolis (St. Austell) there are about a dozen bands. And the China Clay proprietors encourage this partiality for band music by subscribing to band funds, helping efforts organised to raise money for special purposes, and offering prizes and trophies at contests. Last month an effort was organised to raise funds to defray the cost of a new band room for the Penwithick Band, in which Mr. Tom Nicholls, who is interested with his brother, Mr. Hart Nicholls, in North Goonbarrow China Clay Works, has taken a prominent part in organising. Such was the keenness of the men that they provided the labour gratis for the erection of the band room, so that the scheme was carried out for a little over £100. At the luncheon to celebrate the occasion, Mr. John Hooper, of Anchor China Clay Syndicate, Ltd., and a keen supporter of St. Dennis Band, presided, and was supported by Mr. Hart Nicholls, who expressed pride in the fact that he was a native of Penwithick. Dr. H. Newcome Wright declared the new room open, and expressed admiration for the way Penwithick had risen to the occasion.

Champion Band Beaten by a Point

The West of England Bandsmen's Festival at Bugle again proved a big draw, over 5,000 people attending from all parts of the county to hear the contests for the Senior and Junior Championships. After holding the West of England Championship and the Prince of Wales Trophy for four years in succession, St. Dennis Band were beaten by a single point by Kingswood Evengel (Bristol) Band, who were second to St. Dennis last year. The playing was so close, said one of the judges, that had there been time they would have asked the two bands to play the test piece " William Tell " over again. St. Dennis still retains the Cornish Championship, and intend competing at the Crystal Palace again at the end of this month. Stenalees, another well-known clayworkers' band, won the championship for the Second Section Bands.

China Clay Wrestling Champions

The China Clay area of St. Austell has won the distinction of producing the champions in every section of Cornish wrestling, and, what is even more remarkable, they are all employed in the works of English China Clays, Ltd., in St. Stephen's district. The Champion Heavy-weight Wrestler and the winner of Sir Edward Nicholl's Championship Belt is Fred Richards, of Old Pound, Nanpean, a hefty China Clay worker of 25, who is employed as required in his firm's works, where mining operations, such as driving levels and sinking shafts, are undertaken. The champion has attracted the attention of Mr. Eugene Corri, the famous boxing referee. The representative of a London paper who was recently in Cornwall witnessing the catch-weight Wrestling Championship of the county, was struck by the startling possibilities of some of the young giants who took part in it. The most promising among them was F. Richards, of Nanpean, who beat all comers. Young and supple and strong, he was one of the quickest and brainiest wrestlers on the field. Unlike other forms of wrestling, the Cornish style not only demands great strength but the finer qualities of nimbleness and quick thinking, which are among the chief attributes of the champion boxer.

When Richards' photograph was shown to Mr. Corri he was greatly impressed. " I have never seen a likelier young man to be a champion," he said. " He has the grim, fighting face, the beautifully balanced body suggestive of an enormous reserve of strength, and he stands in the manner of a born scrapper. I should very much like the opportunity of meeting Richards. He is young, and I could tell in a few minutes whether he is a possible world beater." Such is the opinion of an expert on the Heavy-weight Wrestling Champion produced by the China Clay industry.

The Lightweight Champion, and the winner of Sir Edward Nicholl's Championship Belt, is Fred Lean, who works in the English China Clay Stone Quarries; and the Junior Champion, the winner of the Cornwall Wrestling Association's gold medal, is S. Hooper, a lad of 17, who is employed in the same company's Dubber works.

On August 27 Mr. F. Venner, another English China Clays' stone quarryman, presided at a largely attended meeting at Nanpean, when the champions were acclaimed, and presented with their trophies by Captain A. N. Willyams from Bodmin, Deputy President of the Association, who acted in the stead of the president, Captain Bisdee, who is with the Army of Occupation at Cologne.

Cottage Hospital China Clay Support

Nearly £2,700 has now been received towards the St. Austell Cottage Hospital Extension Fund, including a donation of £25 from the Prince of Wales, as the Duke of Cornwall. Further donations from companies and persons interested in the China Clay industry have been received by the Hon. Treasurer, Mr. Henry Stocker—viz.: China Clay Workers' Shilling Fund, £105; Mrs. Woodman Peters and Mrs. A. E. Mitchell, £26 5s. each; Manchester China Clay Co., Ltd., £20; Rosevear China Clays, Ltd., Imperial Goonbarrow China Clay Co., Ltd., Mrs. H. Nicholls, Poltair, Mr. and Mrs. H. Nicholls, £10 10s. each; Messrs. E. H. and F. J. Richards, and Miss Ashley, £10 each; Alfred Davies, Lewis S. Peters, Miss Mary Ashley, £5 each; Bloomdale China Clay Co. and United China Clay Co., 10s. 6d. each; Midland Bank, Ltd., £5 5s. In addition to a donation of £50 to the Extension Fund of the hospital, Mr. Frank Parkyn gave 25 guineas to the annual fete at Trevarrick, St. Austell, on August 30, in aid of the Maintenance Fund. Although the fete was marred by wet weather, large crowds from all parts of the clay district rallied to its support, with the result that the remarkable sum of over £430 was realised. The day's events included programmes by nine local bands, a carnival, a trail of coins, and all manner of side shows and stalls organised and superintended by voluntary workers, the China Clay interest being largely represented. Mrs. T. Medland Stocker and her two daughters were in charge of the soap and lavender stall. Mr. G. H. Grenfell, of English China Clays, Ltd., shared with Mr Arthur Rowett the duties of organising secretary of the fete, and is also joint secretary of the Hospital Committee. The fete was opened by Lady Mansel, wife of Sir Courtenay Mansel, M P. for the division of which St. Austell forms a part.

Death of Mrs. Sydney Hancock

After an illness of several weeks, the death of Mrs. Hancock, the wife of Mr. H. Sydney Hancock, occurred on September 5 at the age of 74. Mr. Hancock, with whom much sympathy has been expressed, was, until its sale to Messrs. Grose and

Stocker, manager of Caudledown China Clay Works for Messrs. Thriscutt and Bale, and was a director of the recently disbanded Associated China Clays, Ltd. He is a well-known land agent and surveyor, acting in that capacity for Viscount Clifden, Messrs. Gill and Ivimey, and others.

China Clay Firm's New Factory

The industrial gloom in which Erith, Kent, has been enveloped since the war is lifting a little. Messrs. H. Doulton and Co., manufacturers of tiles and earthenware, of Lambeth, are negotiating for the purchase of 20 acres of land, next to Erith Oil Works on the river front. A factory, also near the river, is being erected by Messrs. H. D. Pochin and Co., Ltd.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

*[NOTE.—The Companies Consolidation Act, of 1908, provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]*

COOKE AND NUTTALL, LTD., Horwich, paper makers. Registered August 21, £15,000 debentures to Miss F. C. Nuttall, Parkside, Darwen; charged on property at Horwich, also general charge. *£1,000. August 11, 1924.

Satisfactions

PENCOED AND DINAS POWIS BRICK AND TILE CO., LTD. (late PENCOED TERRA-COTTA BRICK AND TILE CO., LTD.). Satisfaction registered July 31, £400, part of amount outstanding July 1, 1908.

PORTALS, LTD., Whitchurch (Hants), paper manufacturers. Satisfaction registered August 23, £30,000, balance of amount registered May 25, 1920.

SMITH BROS. (BIRMINGHAM), LTD., paper makers. Satisfaction registered August 5, £425, part of amount registered February 10, 1922.

London Gazette, &c.

Reduction of Capital

CALDWELL'S PAPER MILL CO., LTD. Order of the Court dated July 18, 1924, confirming the reduction of capital from £400,000 to £250,000, registered by the Registrar of Companies August 15, 1924.

August Deliveries

We are this month making a further dissection of the figures relating to the monthly deliveries of China Clay, china stone and ball clay despatched through the usual China Clay channels. Ball clay, sent through other channels do not appear.

	China Clay. Tons.	China Stone. Tons.	Ball Clay. Tons.
Fowey	46,693	4,749	1,500
Newham	—	442	—
Par	4,360	712	—
Plymouth	956	—	470
Charlestown	5,105	—	—
Hayle	240	—	—
By Rail	4,327	—	—
Totals, August	61,681	5,903	1,970
Totals, July	63,912	5,314	9,249

Figures showing total deliveries for eight months ended August compared with corresponding eight months, 1923:—

China Clay. Tons.		China Stone. Tons.		Ball Clay. Tons.	
1924.	1923.	1924.	1923.	1924.	1923.
517,489	503,977	35,541	28,187	25,112	14,071

August China Clay Exports

Return showing the exports of China Clay, the produce or manufacture of the United Kingdom, from the United Kingdom to each country of destination, registered during the month ended August 31, 1924:—

Country of Destination.	Quantity. Tons.	Value. £.
Finland	311	645
Esthonia	520	715
Sweden	73	312
Norway	753	1,223
Germany	1,529	4,289
Netherlands	2,483	6,410
Java	20	99
Belgium	3,990	7,854
France	1,584	3,318
Switzerland	10	20
Spain	766	1,548
Italy	961	2,882
China, Exc., Hong Kong, Macao and other Leased Territories	10	38
United States of America (Atlantic)	31,318	71,032
United States of America (Pacific)	1,599	3,745
Cuba	5	54
Brazil	—	2
Agentine Republic	662	1,082
Irish Free State	10	30
India (other ports)	1,645	6,555
Madras	37	148
Bengal, Assam, Bihar and Orissa	162	648
Ceylon and Dependencies	1	6
Western Australia	1	3
Victoria	11	144
New South Wales	42	198
New Zealand	2	10
Canada	199	454
	48,686	£113,464

July China Clay Exports

*Return showing the exports of China Clay, the produce of the United Kingdom, from the United Kingdom to the several countries of destination registered during the month ended July 31, 1924.

Country of Destination	Quantity Tons.	Value. £
Finland	199	450
Sweden	1,814	5,027
Norway	424	620
Denmark (Including Faroe Islands)	647	1,779
Germany	882	2,405
Netherlands	1,744	4,964
Belgium	5,869	12,241
France	2,389	4,699
Spain	457	1,183
Italy (including Fiume)	3,593	10,777
Greece	40	171
China (excl. of Hong Kong, Macao, and Leased Territories)	7	83
United States of America	20,696	45,907
Mexico	20	80
Columbia	1	6
Brazil	1	8
Irish Free State	20	49
Transvaal	—	1
India (other ports)	638	2,549
Madras	10	40
Bengal, Assam, Bihar and Orissa	314	1,256
Australia, Victoria	4	57
New South Wales	28	150
Queensland	—	1
Canada	1,936	4,550
	41,733	£99,053

* These returns were not published in time for our last issue.

The Associated China Clays, Ltd.

It is anticipated that as a result of the recent break-up of the Association, drastic economies will have to be introduced to meet the new situation, and, if not in wages, a reduction will have to be made in the number of men employed unless a greater volume of trade is secured to counterbalance the effect of the breaking-up of the Association.

Shipping and Export News of the Month

We give below the latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—July, 1924

(Arrived too late for publication last month.)

Arrived.	Name.	Sailed.	Destination.
July 1,	s.s. *Orchis*	July 4,	Rouen
	s.s. *Treleigh*	July 5,	Runcorn
	s.v. *Lady Agnes*	July 16,	Goule
	s.s. *Clydevalley*	July 4,	Weston Point
	s.s. *Pine*	July 4,	Fleetwood
July 2,	s.s. *Malan*	July 5,	Ridham
	s.s. *Annie*	July 5,	Runcorn
July 3,	s.s. *Cervantes*	July 8,	Genoa
July 4,	s.s. *Westdale*	July 8,	Glasson Dock
July 3,	s.s. *Heatherlea*	July 5,	Antwerp
	s.s. *Jolly Laura*	July 7,	Grimsby
	s.v. *Hosianna*	July 4,	Runcorn
	s.s. *Katherine*	July 7,	Charlestown
July 4,	s.s. *Jerseydene*	July 5,	Charlestown
July 5,	s.s. *Ewy*	July 9,	Karls Krona
	s.s. *Shoreham*	July 9,	Preston
July 6,	s.s. *Teespool*	July 19,	Philadelphia
	s.s. *Spaarnestroom*	July 9,	Amsterdam
July 7,	s.s. *Oosteapelle*	July 10,	Antwerp
	s.s. *Alberta*	July 10,	Rouen
	s.v. *Enns*	July 15,	Harburg
July 8,	s.s. *Falmouth Castle*	July 10,	Runcorn
	m.v. *Shamrock*	July 9,	Plymouth
	s.s. *Isabella*	July 12,	Rouen
July 9,	s.v. *Honsea*	July 12,	Harburg
	s.s. *Fairland*	July 11,	Liverpool
	s.s. *Kyanite*	July 12,	Runcorn
	s.s. *Condor*	July 15,	Antwerp
	s.s. *Vilvorde Maritime*	July 15,	Brussels
	s.v. *Olive Branch*	July 16,	Runcorn
July 10,	*Water Witch*	July 18,	Newcastle
July 11,	*Triumph*	July 16,	Par
	Pedestrian	July 21,	Weston Point
July 13,	s.s. *Elvington*	July 17,	Brussels
	s.s. *Allara*	July 19,	Boston, Mass.
	s.s. *Polecappelle*	July 18,	Antwerp
July 14,	s.s. *Florentino*	July 19,	Genoa
	s.s. *Agga*	July 22,	Montreal
	s.s. *Hilherwood*	July 23,	Portland Main
July 15,	s.s. *Lancaster Castle*	July 29,	Portland Main
	s.s. *Malan*	July 21,	Ridham
	s.s. *Jerseydene*	July 21,	St. Malo
July 17,	s.s. *Freeland*	July 18,	Garston
	s.s. *Onyx*	July 23,	Weston Point
	s.s. *Pyrope*	July 23,	Rouen
July 18,	s.s. *Alice*	July 23,	Preston
July 19,	*Alice Williams*	July 30,	Runcorn
July 20,	s.s. *Allenwater*	July 24,	Liverpool
	s.s. *Corla*	July 24,	Bo'ness
	s.s. *Estella*	July 26,	Brussels
	Elisabeth	July 31,	Montylanto
July 21,	s.s. *Falmouth Castle*	July 24,	Weston Point
July 22,	*Emma and Ernest*	*	
	s.s. *Beeston*	July 26,	Larne
July 23,	s.s. *James Tennant*	July 26,	Newcastle
	s.s. *Brier Rose*	July 24,	Manchester
	s.s. *Nephrite*	July 28,	Bo'ness
	s.s. *Letty*	July 24,	Barrow
July 24,	s.s. *Spaarnestroom*	July 28,	Amsterdam
	s.s. *Overton*	July 26,	Gravesend
July 25,	s.s. *Sutton*	July 27,	Antwerp
	M. A. James	July 29,	Charlestown
July 26,	s.s. *Ardenza*	July 30,	Preston
July 27,	s.s. *Industria*	July 31,	Rouen
	s.s. *Pansy*	Aug. 2,	Ridham
	Mary Ann	Aug. 7,	Runcorn
July 28,	s.s. *Ciscor*	July 30,	Genoa
	s.s. *Tanny*	July 29,	Pentewan
	Bidsie and Bell	Aug. 2,	Aberdeen
	Gauntlet	Aug. 7,	Runcorn
	s.s. *Arethusa*	July 30,	Leith
July 29,	m.v. *De Wadden*	*	Rochester
	m.v. *Young Fox*	*	
July 30,	s.s. *Marta*	Aug. 2,	Drammen
	s.s. *Mellonear*	Aug. 1,	Leith
	Windermere	*	
	s.s. *St. Kelwith Force*	Aug. 2,	Liverpool

* Signifies "in port."

Fowey Shipping—August, 1924

Arrived.	Name.	Sailed.	Destination.
Aug. 1,	s.s. *Ualan*	Aug. 5,	Plymouth
Aug. 1,	m.v. *Vera*	Aug. 7,	Brussels
Aug. 1,	m.v. *Ingeborg*	Aug. 2,	Par
Aug. 1,	s.s. *Clara Monks*	Aug. 7,	Weston Point
Aug. 4,	s.s. *Orenie*	Aug. 7,	Appledore
Aug. 4,	s.s. *Cape Comorin*	Aug. 14,	Baltimore
Aug. 6,	s.s. *St. Mawes*	Aug. 6,	Falmouth
Aug. 6,	s.s. *Falmouth Castle*	Aug. 8,	Weston Point
Aug. 6,	s.s. *Katherine*	Aug. 7,	Plymouth
Aug. 6,	s.s. *Ashton*	Aug. 9,	Antwerp
Aug. 6,	m.v. *Shamrock*	Aug. 7,	Plymouth
Aug. 6,	s.s. *Jolly Marie*	Aug. 9,	Antwerp
Aug. 7,	s.s. *Jarvix*	Aug. 11,	Antwerp
Aug. 7,	s.s. *Brier Rose*	Aug. 7,	Grimsby
Aug. 7,	s.s. *Shoreham*	Aug. 12,	Preston
Aug. 7,	m.v. *Hamme*	Aug. 9,	Dundee
Aug. 7,	s.s. *Penrhyn*	Aug. 9,	Runcorn
Aug. 7,	s.v. *Jane Slade*	*	Kirkcaldy
Aug. 8,	s.s. *Elvington*	Aug. 13,	Brussels
Aug. 8,	s.s. *Bordeaux Maru*	Aug. 21,	Philadelphia
Aug. 8,	s.s. *Hayle*	Aug. 14,	Hull
Aug. 8,	s.s. *Spaarnestroom*	Aug. 12,	Amsterdam
Aug. 8,	m.v. *Gertrud*	Aug. 12,	Harburg
Aug. 8,	s.s. *Bruxelles Maritime*	Aug. 13,	Brussels
Aug. 8,	s.s. *Ortona*	Aug. 16,	Ridham
Aug. 8,	s.v. *Julia*	Aug. 23,	Runcorn
Aug. 8,	s.s. *New Resolute*	Aug. 8,	Falmouth
Aug. 9,	m.v. *Elbnymphe*	Aug. 20,	Jarate
Aug. 9,	s.s. *Bronzite*	Aug. 14,	Runcorn
Aug. 9,	m.v. *Shamrock*	Aug. 10,	Plymouth
Aug. 10,	s.s. *Kyanite*	Aug. 14,	Weston Point
Aug. 10,	s.s. *Rose*	Aug. 14,	Lancaster
Aug. 11,	s.s. *Ardenza*	Aug. 15,	Bordeaux
Aug. 10,	s.v. *Pursuit*	*	
Aug. 10,	s.v. *Lady Agnes*	Aug. 12,	Looe
Aug. 11,	s.s. *Coaster*	Aug. 13,	Guernsey
Aug. 12,	s.s. *Bangor*	Aug. 15,	Gravesend
Aug. 13,	m.v. *Shamrock*	Aug. 14,	Plymouth
Aug. 13,	s.s. *Cambalu*	Aug. 18,	Liverpool
Aug. 13,	s.v. *W. E. Gladstone*	Aug. 26,	Porthoustock
Aug. 14,	s.s. *Haufru*	Aug. 16,	Genoa
Aug. 14,	m.v. *Gustav Stein*	Aug. 19,	Plymouth
Aug. 14,	m.v. *Thames*	*	
Aug. 15,	s.s. *Broadgreen*	Aug. 19,	Passages
Aug. 15,	m.v. *May Blossom*	Aug. 15,	Pentewan
Aug. 16,	m.v. *Diligent*	Aug. 16,	Mevagissey
Aug. 16,	s.s. *Egypt Maru*	*	Portland
Aug. 16,	m.v. *Helgoland*	Aug. 20,	Boness
Aug. 18,	s.s. *Ceuta*	Aug. 23,	Montreal
Aug. 18,	s.s. *Falmouth Castle*	Aug. 20,	Runcorn
Aug. 18,	s.v. *Lady Agnes*	Aug. 18,	Charlestown
Aug. 18,	s.v. *Henrietta*	Aug. 18,	Charlestown
Aug. 18,	s.s. *Berklestroom*	Aug. 23,	Amsterdam
Aug. 19,	s.s. *Condor*	Aug. 23,	Rouen
Aug. 19,	s.s. *Marena*	Aug. 23,	Weston Point
Aug. 19,	s.s. *Hilda*	Aug. 23,	Bremen
Aug. 20,	s.s. *Farfield*	Aug. 22,	Weston Point
Aug. 20,	s.s. *Magrix*	Aug. 23,	Gravesend
Aug. 20,	s.v. *Erika*	Aug. 26,	Munkedal
Aug. 20,	s.s. *Pyrope*	Aug. 23,	Fleetwood
Aug. 21,	s.s. *Avanville*	Aug. 25,	Preston
Aug. 21,	s.s. *Brier Rose*	Aug. 25,	Garston
Aug. 21,	s.s. *Coniston*	Aug. 26,	Rouen
Aug. 21,	s.v. *Ellen*	Aug. 22,	Par
Aug. 23,	s.s. *Isabella*	Aug. 28,	Antwerp
Aug. 24,	s.s. *Bruxelles Maritime*	Aug. 27,	Brussels
Aug. 24,	m.v. *Harjumaa*	Aug. 28,	Kotka
Aug. 24,	s.s. *Hampshire Coast*	Aug. 28,	Liverpool
Aug. 24,	m.s. *Isabell*	Aug. 29,	Pentewan
Aug. 25,	m.v. *Shamrock*	Aug. 29,	Plymouth
Aug. 25,	m.s. *Katie*	Aug. 28,	Par
Aug. 26,	m.s. *Antje*	Aug. 28,	Bremen
Aug. 26,	m.s. *May Blossom*	Aug. 29,	Lerryn
Aug. 26,	s.s. *Leaside*	Aug. 30,	Antwerp
Aug. 27,	s.s. *Ferndene*	Aug. 30,	Antwerp
Aug. 27,	s.s. *Sheaf Mount*	*	Los Angelos
Aug. 27,	m.s. *Maria*	Aug. 30,	Gothenburg
Aug. 29,	m.s. *Tower Bridge*	Aug. 30,	Dunkirk
Aug. 29,	s.s. *King City*	*	Portland Maine

Aug. 29,	S.S. *Falmouth Castle*	*	Runcorn
Aug. 30,	S.S. *Condor*	*	Ridham
Aug. 30,	S.V. *W. E. Gladstone*	*	Par
Aug. 31,	S.S. *Ualan*	*	Rouen
Aug. 31,	S.S. *Bronzite*	*	Preston

* Signifies "in port."

Charlestown Shipping—August, 1924

Arrivals

Date	Vessel	From
August 1	*Heatherlea*	Teignmouth
August 2	*Concordia*	Frangsund
August 3	*System*	Plymouth
August 6	*T. P. Filling*	Granville
August 8	*Frances and Jane*	Llanelly
August 9	*Sunshine*	Porthoustock
August 12	*Berthe*	Bordeaux
August 12	*Elise*	Kafso
August 13	*Lord Rosebery*	Plymouth
August 13	*Dunard*	Guernsey
August 13	*Ebbrix*	Par
August 15	*Lady Daphne*	Truro
August 18	*Henrietta*	Looe
August 18	*Lady Agnes*	Looe
August 19	*Romanie*	Exeter
August 22	*J. Milton*	Truro
August 25	*Isabeletta*	Rouen
August 26	*Britisher*	Plymouth
August 27	*Madeleine*	Cardiff

Sailings

Date	Vessel	Destination.
August 4	*Heatherlea*	London
August 6	*System*	Rouen
August 6	*T. P. Filling*	Preston
August 7	*M. A. James*	Preston
August 13	*Frances and Jane*	London
August 14	*Sunshine*	London
August 14	*Dunard*	Preston
August 14	*Ebbrix*	London
August 16	*Concordia*	Granton
August 16	*Lord Rosebery*	Rochester
August 18	*Henrietta*	Runcorn
August 18	*Lady Agnes*	Runcorn
August 20	*Romanie*	Brussels
August 21	*Amanda*	Runcorn
August 21	*Lady Daphne*	Rochester
August 22	*J. Milton*	London
August 28	*Isabeletta*	Preston
August 29	*Britisher*	London
August 29	*Elise*	Gothenburg
August 30	*Berthe*	Nantes

Par Harbour Shipping—August, 1924

Arrivals

Date.		Vessel.	From.
August 1,	S.S.	*Shellie*	Cork
August 2,	S.S.	*Katherine*	Plymouth
August 2,	M.V.	*Ingeborge*	Fowey
August 2,		*S. F. Pearce*	Newport
August 3,	S.S.	*Treleigh*	Portreath
August 6,	S.S.	*Magrix*	Teignmouth
August 6,	S.V.	*Snowflake*	Falmouth
August 6,	M.V.	*Regina*	Plymouth
August 6,	M.V.	*Earl Cairns*	Porthoustock
August 7,	S.V.	*Goliath*	Fowey
August 7,	S.V.	*Triumph*	Plymouth
August 8,	S.V.	*Pet*	Mevagissey
August 10,	S.V.	*Rosina*	Plymouth
August 11,	S.S.	*Ebbrix*	Hull
August 11,	S.V.	*Duchess*	Mevagissey
August 13,	S.V.	*Amy*	Truro
August 14,	S.S.	*Katherine*	Plymouth
August 14,	S.V.	*Hosianna*	Falmouth
August 14,		*J.N.R.*	Plymouth
August 15,	S.S.	*Elsie Thomas*	Barry
August 15,	S.S.	*Westdale*	Plymouth
August 17,	S.V.	*Flower o' Portsay*	Porthoustock
August 19,		*Ryelands*	Penryn
August 22,		*Ellen*	Plymouth
August 23,		*Guiding Star*	Falmouth
August 24,	S.V.	*The Sirdar*	Plymouth
August 26,	M.V.	*Regina*	Plymouth
August 27,	M.V.	*Hanna*	Torquay
August 27,	S.V.	*J.N.R.*	Plymouth
August 27,	S.V.	*Lucy*	Plymouth
August 27,	S.V.	*Paquerette*	Littlehampton
August 28,	S.S.	*Shellie*	Jersey
August 28,	M.V.	*Katie*	London
August 29,	S.V.	*Bulla*	Porthoustock
August 29,	S.S.	*Katherine*	Plymouth
August 30,	S.S.	*T. P. Tilling*	Hull

Sailings

Date.		Vessel.	Destination
August 2,	M.V.	*Katie*	London
August 2,	S.V.	*Flying Foam*	Runcorn
August 2,	S.V.	*Rita*	Gravelines
August 2,	S.V.	*Henrietta*	London
August 2,	S.V.	*Ivy*	Queenborough
August 5,	S.S.	*Katherine*	Pentewan
August 6,	S.S.	*Shellie*	Fleetwood
August 6,	S.S.	*Treleigh*	Antwerp
August 7,	S.S.	*Magrix*	London
August 8,	S.V.	*Regina*	Pentewan
August 12,	S.V.	*Marian*	Runcorn
August 12,	S.V.	*Ingeborge*	London
August 12,	S.V.	*Snowflake*	London
August 13,	S.S.	*Goliath*	Fowey
August 13,	S.S.	*Triumph*	Plymouth
August 13,	S.S.	*Ebbrix*	Charlestown
August 14,	S.S.	*Katherine*	Pentewan
August 15,	S.V.	*Earl Cairns*	Runcorn
August 16,	S.V.	*J.N.R.*	Pentewan
August 18,	S.V.	*S. F. Pearce*	Antwerp
August 18,	S.V.	*Amy*	Newcastle
August 18,	S.S.	*Elsie Thomas*	Runcorn
August 18,	S.S.	*Westdale*	Preston
August 19,	S.V.	*Duchess*	Runcorn
August 19,	S.V.	*Rosina*	Queenborough
August 22,	S.V.	*Hosianna*	Runcorn
August 26,		*The Sirdar*	Pentewan
August 27,	S.V.	*Flower o' Portsay*	Penarth
August 27,	S.V.	*Regina*	Pentewan
August 29,	S.V.	*Pet*	Western Point
August 29,	S.S.	*Ryelands*	Dunkirk
August 29,	S.V.	*J.N.R.*	Pentewan
August 29,	S.S.	*Shellie*	Fleetwood
August 30,	S.V.	*Ellen*	Frederichshall
August 30,	S.V.	*Guiding Star*	Runcorn
August 30,	S.S.	*Katherine*	Pentewan

Par Harbour Tide Table, September, 1924

(British Summer Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Monday	1	7.36	7.53	13.1
Tuesday	2	8.10	8.27	13.4
Wednesday	3	8.46	9.6	13.1
Thursday	4	9.25	9.45	12.8
Friday	5	10.4	10.27	12.0
Saturday	6	10.52	11.20	11.2
Sunday	7	11.52	—	10.5
Monday	8	0.30	1.13	10.5
Tuesday	9	1.57	2.41	11.1
Wednesday	10	3.23	3.59	12.0
Thursday	11	4.32	5.1	13.0
Friday	12	5.27	5.53	13.6
Saturday	13	6.15	6.35	13.9
Sunday	14	6.56	7.16	13.4
Monday	15	7.34	7.52	13.6
Tuesday	16	8.6	8.24	13.2
Wednesday	17	8.40	8.56	12.8
Thursday	18	9.12	9.27	12.0
Friday	19	9.43	10.1	11.2
Saturday	20	10.20	10.38	10.4
Sunday	21	11.2	11.31	9.7
Monday	22	—	0.4	9.3
Tuesday	23	0.44	.29	9.5
Wednesday	24	2.11	2.51	10.2
Thursday	25	3.27	3.59	11.3
Friday	26	4.26	4.50	12.1
Saturday	27	5.11	5.33	12.9
Sunday	28	5.53	6.12	13.4
Monday	29	6.31	6.51	13.5
Tuesday	30	7.9	7.28	13.10

E. CLEMENS, Harbour Master.

The China Clay Trade Review

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Contents

	PAGE
EDITORIAL NOTES	7–8
Pottery Trade Prospects	9
China Clay Works Visited	10–11
China Clay in Rubber	14
Coloured Glaze for Porcelain	15
China Clay Hydraulics	16
China Clay Notes	17
Shipping and Export News	19–20

China Clay Association Dissolution Aftermath

A GOOD deal of discussion on the merits and demerits of the China Clay Association, which was suddenly dissolved last month, has been going on in China Clay circles, and has found ventilation in the Press. Mr. A. Courtney, whose firm—The Ruddle Common China Clay Co., Ltd.—precipitated the crisis which led to the Association being wound up, has been giving his views to the Press in justification of his action, alleging that it was the Association's price policy which operated to the advantage of best clays and to the detriment of common clays, that led to discontent among members of the Association. He also alleges "that the interests of the producer of common clays generally" were subordinated to the interests of the common clay producers who could not produce at competitive prices. His further indictment against the Association is that it "has not had any policy of trade development—it has had its Advisory Committee, its Sampling Committee, its Classification Committee, and many other committees, but no committee for trade development, and when this has been suggested it has been met with the statement that this is best left to the individual producer."

Mr. Courtney thinks that "with the dissolution of the Association it necessarily follows that prices will be unstable for a period, but under the new conditions that will prevail it cannot be doubted that a serious effort will be made to recover the markets which have been lost, and it will certainly be possible to effect very appreciable economies in the costs of production without any reduction in wages. It can be accepted as a fact that every possible ton which can be sold will be shipped from the clay district, and we can reasonably look forward to a considerable increase in tonnage—if not in the immediate future—within a reasonable period, and after present contracts for foreign and outside clays have been liquidated." Mr. Courtney goes on to say: "The state of lethargy in which the trade found itself under the Association is now at an end. The trade will wake up, and there will be more activity and life in the free air of competition; the industry will be more healthy and more economically sound. So far as one can see at present, it would be possible to maintain wages at their present level, but the fact must not be overlooked that it is necessary for the industry that it should be able to produce China Clay at a price at which it can be sold in the markets of the world, if the trade is to be run on a sound economic basis. That China Clay in Cornwall can be produced at such a price now it is free from restrictions I have no doubt. For myself I am not concerned for the future of the industry, but I was concerned for the future of the common China Clay trade under the policy adopted by the Association China Clays, Ltd."

These, briefly, are the arguments Mr. Courtney has advanced for justifying his championship of the common clay producers. The other side of the picture is that the majority of the common clay producers do not take the same view of the lack of usefulness of the Association that Mr. Courtney has taken, and regret its dissolution. Into the internal arrangements of the Association as they operated in relation to common or best clays, we refrain from entering, as they concern the firms comprising the Association, but whatever were the weaknesses, advantages or otherwise of the Association as an organisation, the members who comprised it were responsible for whatever arrangements were made in what they considered were the best interests of the trade as a whole. And, as in all such bodies, the majority ruled. As regards the ethics of the Association from an economic standpoint, we have always held the view that its existence could only be justified as a temporary expedient to rectify by artificial means a very abnormal condition of trade due to disturbed world conditions. Until those abnormal conditions had passed a large number of producers felt that the Association, which has been of such benefit to the industry as a whole, should be continued. Mr. Courtney thinks differently, and suggests that we have approached normal conditions when "the free air of competition" may be allowed to operate. We agree with him that increased quantities of China Clay will be sent away, but inasmuch as much of those increased quantities will be disposed of at a loss, it will be of very little benefit to the China Clay district. It can only result in such severe economies as will react for some time to come upon the economic position of those actually engaged in the production of China Clay. Now that the industry has been suddenly thrown into a price-cutting war, we can only hope that the results will be eventually as satisfactory as Mr. Courtney anticipates. So far, the trade done in common clays since the break-up of the Association has not been very profitable for the firms concerned.

About Ourselves

INFORMATION has been sought by readers of *The China Clay Trade Review* in America on the part played by China Clay in the manufacture of alum cake, its use as a sewage purifier, and other lesser known uses. Most readers are aware that the great bulk of China Clay is sent to the paper mills and potteries, but there are a very large number of other uses for this valuable raw material, and it has been the pleasure of this *Review* from time to time, by special articles, to keep its readers informed of some of these. In our July issue we published an article on China Clay as a sewage purifier, and last month we printed an informative article on China Clay and alum cake. We intend to continue these articles, as there is evidently a strong demand for such information. Our subscribers from the commencement of the *Review* know that such information has been published before, but with the growing

list of new readers it would appear necessary to repeat some of the previously published articles. We appreciate such letters asking for information from our readers, and can assure them that no efforts will be spared to give them the desired replies, either by letter direct or by special articles in this *Review*.

An article on "China Clay in Rubber," published on another page of this issue, will be read with interest, and deals with a new invention, for which a patent has been applied, having for its object improvements in the manufacture of rubber compositions containing China Clay. In this invention it is claimed that the effect of addition to vulcanizable rubber mixings of clay of a lowered degree of acidity gives an increased speed of cure, a greater breaking strain, and in the elongation at break of the vulcanized product.

Such articles as these should prove of value and interest not only to the China Clay producers but to those engaged in the mixing of rubber. One of the inventors of this process is well known as a China Clay producer, which goes to show that he is working upon lines which should help to increase the output of China Clay. The more that is known of such subjects in which China Clay plays a prominent part, the better for the trade as a whole.

The *Review* has always made a point of publishing articles which may appear in foreign papers of the discovery of China Clay and the opening up of China Clay works in other countries. The information is always interesting, and, even when written to give the best impression of the clay of the country in question, shows every time that best English China Clay has no superior the world over.

By our illustrations of the works and pits of prominent China Clay companies, we feel that we are doing our share in informing the world of the valuable deposits of China Clay not only of the particular company referred to, but incidentally of Cornish and Devon China Clay companies as a whole.

The China Clay Trade Review, issued as a supplement to THE CHEMICAL AGE the third week in every month, is found in every part of the globe and, as our letter bag shows, has done much to arouse interest in the uses of China Clay. Our experience has taught us that, though other countries may find and work China Clay of sorts, nowhere in the world is to be found, or likely to be found, the superior to best English China Clay.

The Problem of "Stent"

(BY "CHINA CLAY CAPTAIN.")

IN washing away the virgin clay the clayworker does not find the stope exactly uniform in quality. Running through the decomposed granite there are white and blue spar lodes varying in width from a couple of inches to 8 or 10 ft. wide. Occasionally blue and yellow elvin lodes are found, in addition to the foregoing bunches of rocks, like hard kernels surrounded with washable clay, which has to be moved. Again there is what is known as granite upheaval or granite "islands"; to obtain the clay around them—for they stand almost vertical—these have to be removed.

All this—spars, quartz crystals, elvins, tinstones, granite and tourmaline rocks, hard "clatts" (clods), that will not wash farther than the foot of stope—is known as "stent" (literally stones).

Generally speaking, spar lodes are welcomed in a stope, if not too large, as right alongside them the clay appears to be richer and more productive—a case of "nearer the bone sweeter the meat." Some speak of spar lodes as the mother of the clayworks, arguing that fluorine or some other free acid emanated or percolated through them and helped to break down or decompose the original granite. This theory seems feasible, because, as I remarked before, the clay usually appears "fatter" near the lodes.

However, be that as it may, the removing of the "stent" is a problem which appears harder to solve than, for instance, sand. It is a far cry from the days of "landing" sand to the present box pit, where sand can be dealt with speedily and economically, but "stent" is not so easily handled. When in large lumps, it has to be blasted; then filling "stent" is rather an undesirable job at the "strake bottom," with an uneven floor to shovel on; then it must be trammed to pit or skip, and when tipped into an incline-wagon it needs a very strong skip to stand the racket of tipping rocks into it.

Again, when tipping on top of the bank the stones roll in all directions—rather a nuisance where the tip has a restricted area. In fact, "stent" is the bugbear of the China Clay captains in the larger works producing, say, 50 tons of clay per day. If 50 tons of "stent" does not go over the tip as well, it is not long before the stope looks like a stone quarry, the output becomes restricted, and the manager is about to find out "what is the matter."

In addition to the above, it scratches the washer's boots, crushes his toes and, if he is not careful, cuts his fingers, as a broken spar is as sharp as a razor. Then there is always the danger of a stone running amok down the stope and bowling the washer over; again, the little pieces "choke up the tie," silting up at foot of strake causing "losing of stope." So from start to finish "stent" is a recognised nuisance.

In dealing with "stent" the most laborious part is to get it from the "foot of strake" to sandpit. At present, if it is not far, wheelbarrows are used; if a greater distance, tramwagons. If some kind of a conveyor could be invented to carry it back to the pit without shovelling it would be a great improvement. I have sometimes wondered if a steel plate launder were laid down, whether the washing stream in the larger works would not wash back all but the big lumps, which, filled by hand, would not be so bad for loading.

The Wound-up Association

To the Editor of THE CHINA CLAY TRADE REVIEW.

SIR,—I have read the letters to the Press from Mr. A. Courtney (Ruddle Common China Clay Co., Ltd.), and am sorry at the attitude he has taken up. Mr. Courtney does his best to make a case, but when we consider that practically the whole of the producers of clay were strongly in favour of continuing the Association, must it be assumed that Mr. Courtney has a better knowledge of the trade than men who have spent a lifetime's experience in it? In good times the demand would give a fair price, but in slumps in trade the clay has almost to be given away. The common clays in these times suffer the greatest. Mr. Courtney can show up the imperfections of the Association (and it had no doubt its shortcomings, like most of us), but the fact remains that it stabilised prices, and was the producer's only safeguard against undue price-cutting as a result of over-production. If the common grades are practically given away, what economies can be effected other than by cutting down wages? Why should men's wages be cut simply because some people prefer to give their clay away to the foreigners?

Another fact Mr. Courtney seems to overlook is the value of clay mines without the Association. As everybody knows, mines changed hands at fabulous prices on the strength of the Association, and I have no doubt these same mines would not now make half the money. What more proof is wanted than this of the value of the Association to the producer? In my view the Association should have gone on. I believe that before long, firms who have kept outside the Association and Mr. Courtney, will get "fed up" working for nothing, and will learn the lesson when too late that "United We Stand, Divided We Fall." Some of us believe that Mr. Courtney has done us already irretrievable harm, and we trust the *China Clay Trade Review* will use its influence still to bring the members of the trade together.—Yours, etc.,

"CHINA CLAY."

China Clay Prices

THE break-up of the "Associated China Clays, Ltd." was quickly followed by a general lowering of prices. So rapid was this lowering and so great the reduction, that prices have now reached their lowest points. Consumers would be well advised to place their contracts at once, as the market is bound to stiffen—producers are at the moment selling, in many cases, actually below cost of production. This cannot continue—hence the tip to place contracts before the inevitable rise takes place.

Pottery Trade Prospects

Holding Its Own for Quality

THERE are indications that the pottery trade is improving. Summarising the views recently expressed by people closely associated with the industry, we gather that August is always a flat time for the pottery industry, and this year it has been exceptionally so. It is gratifying, therefore, to see unemployment figures falling again, and to note evidences of returning activity in the numbers of operatives going to and returning from work and in livelier conditions on the factories. With the coming of October, and with the hopes of better orders for the autumn and winter trade, busier times should be experienced.

The pottery industry, in common with other trades, has suffered a long depression, but on the whole it has fared better than many other trades. Even during the worst periods, some sections of the industry, or some departments of factories, have maintained practically full time, while individual potteries have seldom fallen below half-time working, which, taken in the aggregate, is a better record than many trades can show.

What a Revival Depends On

So far so good, but there is room enough for improvement in trade conditions. He would be bold who would prophesy the time of a definite revival of the pottery industry. It is dependent on a renaissance of the staple trades of the country—coal, iron, steel, engineering and shipbuilding in particular—for, when times are bad and money is short, one of the last purchases is that of a new tea or dinner service; and naturally so, for pottery is a necessity only in a very minor degree. It is dependent, too, on a return of world confidence, on a restoration and stabilisation of international finance, and a consequential expansion of trading between the nations of the world, for the pottery industry cannot live upon this country alone; its proportion of overseas to home trade has increased in recent years, and in the future it must find a still larger outlet for its productions in the markets overseas.

A VIEW OF A POTTERY TOWN FROM THE AIR.

Quality Tells

But a revival will come at probably no distant date, and the most hopeful factor to the development of the Staffordshire pottery industry is the very definite advance in quality which has been achieved since the war. During the war period and immediately after, when demand totally exceeded supply, there was a not unnatural tendency to a lower standard; indeed, it was inevitable, since many of the skilled operatives had perforce been displaced by substitute labour. There was also the period of "capturing German trade" when some manufacturers adopted the mistaken policy of making down to the low standard of the foreigner. That is all past; manufacturers quickly saw the error of their ways. They have since demonstrated their realisation of the certain truth that the future of the English pottery industry lies in the unsurpassed and unequalled quality of their wares, whether of the humbler or the more pretentious grades.

It is certainly an outstanding feature of the pottery industry that both branches and individual factories have raised their standard of quality materially. Factories which in the old time avowedly made low-grade wares have given such attention to technique and, incidentally, also to design that their productions have become more or less competitive with those of medium grade factories; and this advance has likewise been achieved throughout the various classes of wares, to the highest and costliest. This, indeed, is the real solution to competition with the foreigner. He will probably always have advantages of cheaper labour and cheaper production in the aggregate; but, so long as Staffordshire leads the way in quality, our manufacturers will always find markets where quality has the preference.

Export Expansion

The greatest hope and encouragement in this direction is the fact that various markets of the world are demanding wares of higher technical and artistic quality than formerly. The United States has for very many years been the purchaser of the highest grades of English pottery, but nowadays Australia and New Zealand, for example, are demanding better classes of wares, distinguished by refinement and good taste, so long as they are fairly moderate in price. South America, which in the memory of many living potters bought principally the coarser grades of pottery and great quantities of white granite, nowadays takes a considerable proportion of wares of the higher classes.

Cornish and Devon Raw Materials

This advance in discrimination and taste is all to the advantage of the English potter, whose business it must be to continue to make the pace in quality, both for the purchaser and the foreign manufacturer. With such tradition as the Staffordshire potter possesses, with the innate good craftsmanship of the operatives, and with the aid of the scientist, the soundly equipped designer, and such fine raw materials as Cornwall and Devon supply in China Clay, china stone, ball clay and felspar, this advance in quality can steadily be maintained.

A Suggestion for a Conveyor

To the Editor of THE CHINA CLAY TRADE REVIEW.

SIR,—As a constant reader of your valuable publication—one who appreciates its *educational* as well as its publicity value, which I know is very great—I have been interested in the descriptions given from time to time of modern methods for dealing with sand and overburthen at the clay-pits and also the very full description of the new conveyor at Fowey for loading China Clay, from which it appears that these expeditious and labour-saving devices leave little to be desired and small room for any improvement; but it has often struck me when I have seen a crowd of men loading a "race of trucks" alongside a drying kiln (especially when the linhay is nearly empty, with as many as 50 men to load, say, 10 or 12 trucks) that it is very remarkable that more has not been done to introduce some mechanical contrivance, especially where new dries have recently been built alongside the railway.

I know that at some places a railway has been laid under the storing shed, after the style of the "Patent Sand Pit," but with the difficulty of shunting and getting trucks into position it still leaves something to be desired. Personally, I think that a belt-conveyor laid in a covered channel longitudinally from end to end, under the floor of the clay-shed, the bottom of the shed to be V-shaped so that the clay would roll on the belt as the covers are taken off, would answer the purpose; the belt to feed a chute fixed and covered just outside the end of linhay to get the necessary elevation, the clay falling from chute into the centre of truck; the railway outside to be slightly inclined so that one man could, with the brake, keep the trucks just moving on and another "trimming" and, with a hatch, block the mouth of chute while one truck is being replaced by the next—say two men inside drawing traps and feeding and regulating the clay falling on the belt.

If four men could load 10 trucks—100 tons—in half an hour it is perfectly obvious that the saving in time and labour would be enormous.

I wonder, if anyone else has thought of experimenting along these lines, would they state their views in *The China Clay Trade Review?*

"ONE INTERESTED."

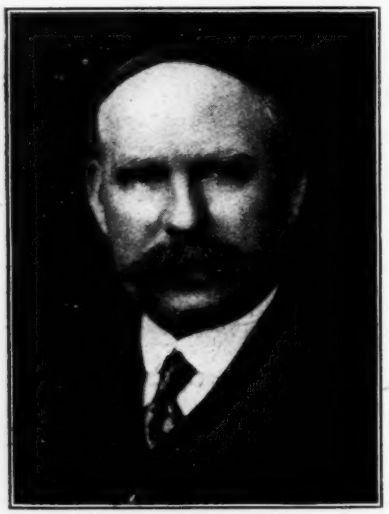
China Clay Works Visited

By "Clayopolis"

(1)—Glynn Valley and Halviggan

The following is the first of a series of articles to be published in the China Clay Trade Review *section of* The Chemical Age. *They are written by an expert after a personal visit to the works described.*

Since the Cornish Kaolin, Ltd., works at Glynn Valley, Bodmin Road Junction, came under the present control in 1921, and Halviggan and North Halviggan, near St. Austell, were acquired by Tehidy Minerals, Ltd., about the same time, great strides have been made in the development of these works and production is now on a large scale. Messrs. Bewick Moreing and Co. are the managers of both companies; Mr. R. M. Richards, who has had a lifelong experience in clay works management, being the superintendent of the works.



Mr. R. M. Richards,
Tehidy Minerals China Clay Works Superintendent.

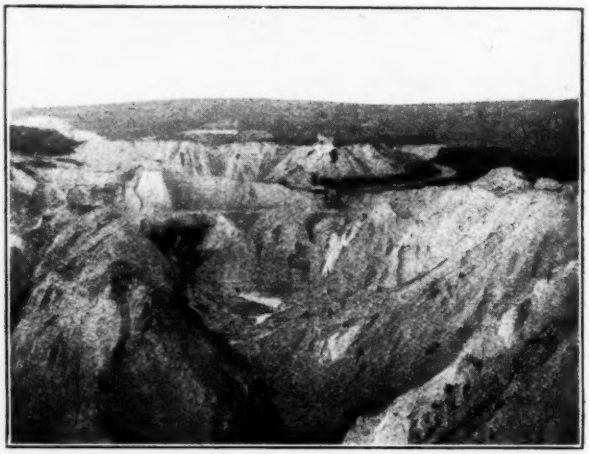
Dries at Bodmin Road Junction

When I was shown over the Glynn Valleyworks by Mr. R.M. Richards and his son, Mr. William Richards, I was surprised to note the extent of the developments in so short a time, and the large scale on which developments are still being carried out to cope with their productive capacity. First I visited the dries which had been erected on the G.W.R. siding on their main line at Bodmin Road Junction, the pits being situated some eight miles distant on the Bodmin Moors, whence the liquid clay is piped.

One dry is 275 feet by 15 feet, and the other 300 feet by 15 feet, each having a capacity of 12,000 tons per annum. The third dry, which is in course of erection, is 260 feet by 16 feet 6 ins., and will have similar capacity. This new dry is expected to be completed by the end of the year, which will then give the Cornish Kaolin dries a total capacity of 36,000 tons per annum. The storage tanks at the rear of each dry range from 600 to 700 tons each. Usually, when the clay is pumped from the works at a distance, it runs direct into the tanks without any intermediate settling, but at Bodmin Road dries a system of conical settlers has been introduced into which the clay runs to settle off the water before it is run into the tanks. Consequently, after the clay gets into the tanks it is of the right consistency for tramming on to the pans for drying in a shorter time than would otherwise be the case.

Bleaching and Potting Clays

Medium bleaching and potting clays are produced at the Cornish Kaolin works, and with adequate drying capacity the two grades can be dried at the same time and kept separate in the linhays. With the completion of their third kiln, these drying facilities will be considerably augmented. The dries are erected on the side of a hill in picturesque surroundings, and the railway sidings being at the base of the slope the company has made the fullest use of this natural advantage by providing for extensive linhay accommodation. At the head of the linhay in one dry a milling apparatus has been installed to cope with the demands of a special market for milled China Clay the company has cultivated. The mill is so arranged that the clay as dried can be thrown into the hopper which feeds the pulverisers, these ejecting the milled clay through shutes into specially lined bags for the export trade. The mill is worked by an oil engine.



Tehidy Minerals, Ltd., View of Halviggan Pit.

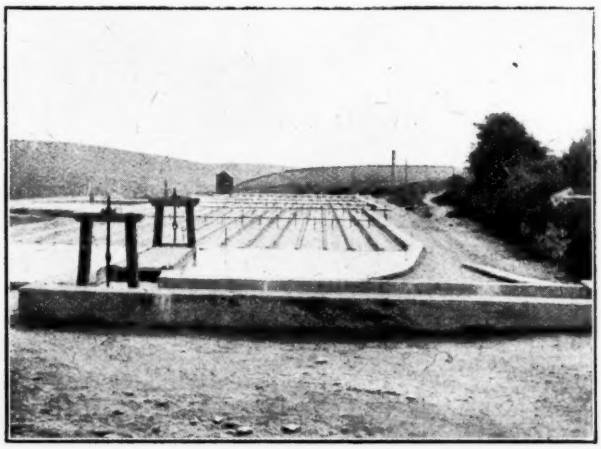
Works on Bodmin Moors

Following my inspection of the company's up-to-date drying plant at Bodmin Road Junction, Mr. Richards, junior, accompanied me on a visit to the pits, which are reached after an eight-mile motor climb through the beauties of the Glynn Valley.

Cornish Kaolin, Ltd., Glynn Valley Pit.

The pits are situated about two miles distant from Mr. Frank Parkyn's works at Temple, and about three miles distant from the Park China Clay Works in the neighbourhood of St. Neot. Bodmin lies between seven and eight miles to the west. The works were started by the present company's predecessors in 1908, in a moderate and, in some respects, old-fashioned way. Since the present company started operations at the beginning of 1921, a 180 h.p. twin National gas engine and plant have been installed; these drive an 85 kilowatt generator put in by the General Electric Company.

This up-to-date plant has displaced oil engines formerly used, and provides the power for all the pumping and winding required on the works. The sett is hundreds of acres in extent, the area of the pit now operating being about twenty acres. From different parts of the pit two excellent medium grades of bleaching and potting clays are being produced, the clay being of such a character that it is effectively washed by hoses

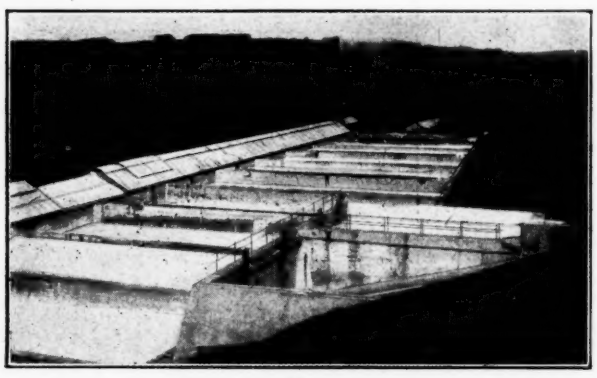


CORNISH KAOLIN, LTD., GLYNN VALLEY SETTLING PITS AND TANKS.

of high pressure produced by gravitation, there being no necessity to break the clay with picks as is the case in some works.

Pumping Plant

To eliminate the pumping to the surface of excessive quantities of water, the liquid clay is pumped up thick through three syphons into a deep trough 100 feet long before it reaches the drags leading into the micas. At a point about twenty feet below where the thick clay enters the trough, a stream of water is introduced by means of an electrically-driven water pump which lifts the water from the surface reservoir and thins down the clay to the necessary consistency before it flows on to the micas. This auxiliary electric pump was installed by the Harland Engineering Co., Ltd., of Manchester, and the China Clay pumps by the Pulsometer Engineering Co., of Reading. The latter deliver 1,500 gallons of clay per minute.



CORNISH KAOLIN, LTD., GLYNN VALLEY TANKS AND DRIES AT BODMIN ROAD JUNCTION.

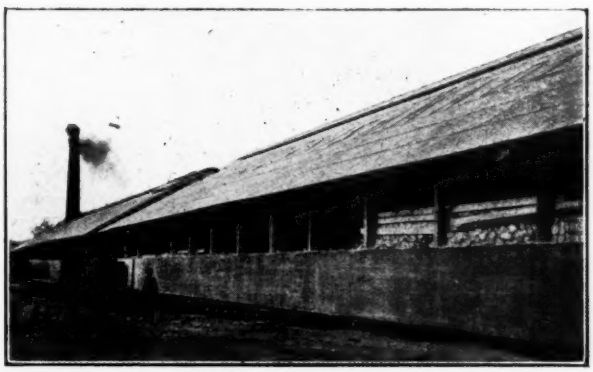
Mr. Richards has introduced a similar system of thinning down the clay at the surface at Halviggan works also, and this tends to reduce the cost of clay pumping to a minimum. From the delivery troughs the clay flows on to a channel that serves as a drag, 16 feet deep and 50 feet long, in which the coarser material in the stream is deposited. The effluent then runs into a conical mica catch-pit, overflowing into the mica runs, the first consisting of 14 divisions spreading out to 24, so that by the time the clay stream enters the four conical settlers at the end of the micas it is highly refined. These settlers are "self-landing," that is to say, they each have a centre plug which, when released, allows the settled clay to flow into the pipes carrying it to the dries, without any manual assistance. The return water from the micas flows into the storage reservoir, from which the above-mentioned thinning pump is fed, and also the water to feed the hoses working in the pit.

About fifty men are employed on or about the pit, which under the present management is opening up exceedingly well, there being tens of thousands of tons of clay in sight without the necessity of breaking virgin ground.

At Halviggan Works

On a subsequent day, accompanied by Superintendent Richards and Captain Kelly, secretary of Tehidy Minerals, Ltd., I paid a visit to Tehidy Minerals' Halviggan and North Halviggan setts, about 2½ miles to the north of St. Austell, which are under the same management as those at Glynn Valley. The Halviggan works and lease were acquired by Tehidy Minerals, Ltd., who are the freeholders, from H. D. Pochin and Co., Ltd., and subsequently added the adjoining sett of North Halviggan, of which Tehidy Minerals are also the freeholders, the lease of which they took over from Mr. Frank Parkyn, whose firm's well-known Blackpool works adjoin.

The Halviggan pit, which has been worked for years, is about twenty-five acres in extent, the sett of this and North Halviggan property covering several hundreds of acres. Best and medium bleaching clays are produced from different parts of the pit.



CORNISH KAOLIN, LTD., DRY SIDING AT BODMIN ROAD JUNCTION.

Energetic Expert Management

The practical superintendence of the works is in the capable hands of Captain R. M. Richards, who may be said to have had lifelong experience of China Clay. For the past 35 years Mr. Richards has been continuously engaged in the development of China Clay properties; he commenced his career at Single Rose China Clay Works, now controlled by Mr. E. J. Hancock, subsequently taking up duties for the development of the Rock Hill China Clay Works, owned by his late uncle, Mr. R. Richards. In 1906 he was engaged to undertake the laying out and full development of the North Cornwall China Clay Works at Stannon Moor, now controlled by the English China Clays, Ltd. In January, 1921, he took up his present appointment under Bewick Moreing and Co., the joint managers of Cornish Kaolin, Ltd., and Tehidy Minerals, Ltd., whose total output is controlled by Varcoes China Clays, Ltd. of St. Austell, on whose board Messrs. C. A. Moreing and A. H. Moreing are directors, Mr. C. S. Varcoe being the managing director.

Under the energetic management of Bewick Moreing and Co., coupled with the practical experience of Mr. Richards, the Cornish Kaolin and Tehidy Minerals properties at Glynn Valley and Halviggan have been developed into highly productive concerns, and they only await the Continental trade revival we all anticipate, to share to an even greater extent than they are at present doing, in the prosperity of the China Clay industry.

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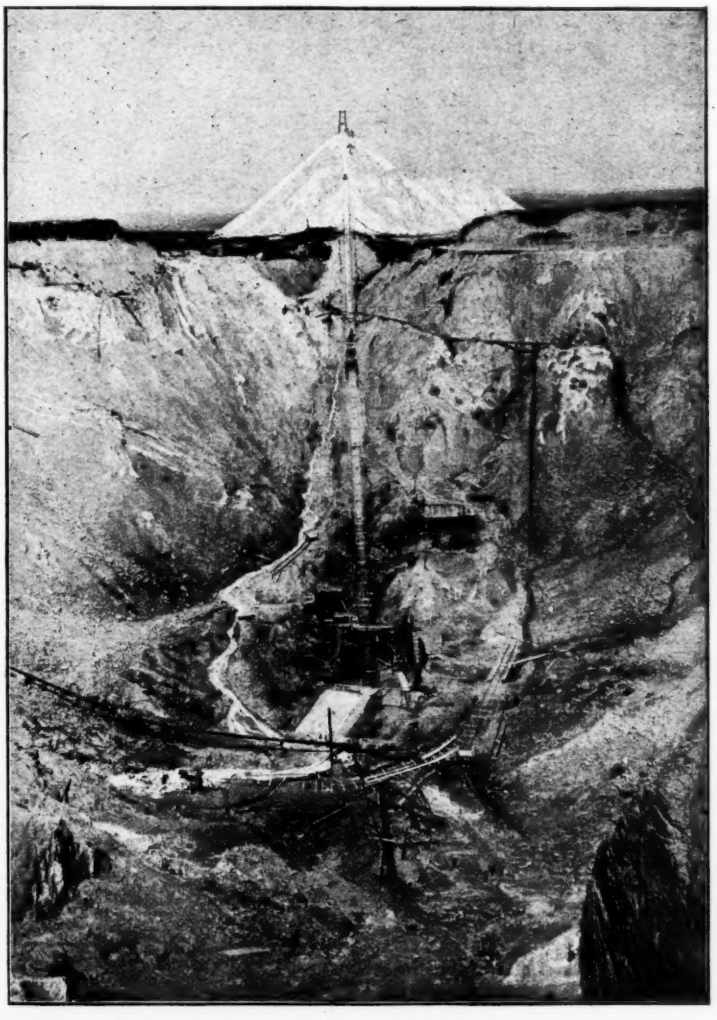

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China Clay in Rubber

New Patent Applied For

A PATENT has been applied for (No. 218364) for an invention having for its object improvements in and relating to the manufacture of rubber compositions containing China Clay. The patentees, who have previously undertaken a considerable number of experiments with a view to the use of China Clay for special purposes, are William Feldenheiner, who is well known in China Clay circles, and Walter William Plowman, who has been associated with Mr. Feldenheiner for many years in laboratory work.

The use of ordinary China Clay in the manufacture of vulcanised rubber has been adopted by rubber manufacturers for many years. The discovery recently made by Schidrowitz and by Feldenheiner and Plowman is that if clay be brought into suspension in water by aid of a peptising agent and thereafter separated by flocculation, there is a marked diminution in the advantageous properties of the rubber compositions with which such clay is incorporated, when the latter has been flocculated by addition to its suspension of a strong acid or a salt thereof, such, for instance, as sulphuric acid or a sulphate such as alum, which is commonly employed as a flocculator for clay. To non-technical readers it may be explained that a flocculator is something that causes the material treated with it to coalesce and adhere together in locks or flakes, and a deflocculator, or the process of deflocculation, brings about separation.

Flocculators for Clay

When an excess of a strong inorganic acid or its salt—for example, hydrochloric acid, sulphuric acid, sodium chloride or alum—has been used to bring about the flocculation of the clay, the addition of the latter to rubber mixes, which are vulcanised to produce soft rubber goods, not only retards the speed of vulcanisation, but affects deleteriously the properties of high breaking strain and tensile strength of the product. With some clays the concentration of alkaline deflocculator required to effect deflocculation is high, in which case the quantity of flocculator necessary for effecting flocculation is correspondingly high, and in some instances two or three times the amount of flocculator may be necessary in comparison with the amount of deflocculator previously required for the preceding deflocculation. In such a case, should the flocculator be, for example, alum, the whole of the advantages derivable from deflocculation may be lost, and the results yielded by the rubber mix may actually be substantially worse than those given by the same clay without any deflocculation treatment.

How the China Clay is Treated

For convenience, the condition of the flocculated product which is brought about by the employment of this type of flocculating agent and which is responsible for reducing the advantageous properties of the rubber compositions is referred to as "acidity," although the term as employed in this special connection has not the popular significance usually attached to it.

According to the present invention, the manufacture of rubber compositions containing clay is characterised by the selection for incorporation with the rubber mixing of a clay having an acidity lower than that possessed by clay as ordinarily flocculated from its suspensions, by addition thereto of a strong acid or a salt thereof.

The clay of such lower degree of acidity may be obtained by neutralisation with alkali of a clay which has been flocculated by aid of a strong acid or its salt and decantation, or, where possible, by repeated washing with water. Alternatively, the clay may be prepared by effecting the flocculation by addition to the clay suspension of a weak acid or a salt thereof, or in some cases a basic reagent may be employed as the flocculator. Thus, the flocculation may be brought about by the addition of the bicarbonate of an alkali metal, or an organic acid, such as acetic acid.

Certain clays are known which, instead of being deflocculated by the usual deflocculators—for example, normal sodium carbonate or caustic soda—are flocculated by the reagents at all concentrations. This behaviour of such clays may be turned to account for the purposes of the present invention by utilising these alkaline reagents for effecting the flocculation, because so long as the flocculator is alkaline and not acid the deleterious effect upon the physical properties of the rubber mixing will not be produced.

The clay of the necessary lower degree of acidity referred to comprises, therefore, clay which is neutral or slightly alkaline.

It is found that a strong acid or its salt, such as sulphuric acid or alum, may be utilised with effects equivalent to those produced by salts of weak acids if the flocculation with the strong acid or its salt is carried out in presence of a colloid substance such, for instance, as resin, which reduces the concentration of the deflocculator necessary for effecting deflocculation.

What Experiments Revealed

To illustrate the principle embodied by the present invention the following facts are cited :—

Six lb. of China Clay were deflocculated by ½ oz. of sodium pyrophosphate in a barrel containing 6 gallons of soft water. The suspension is left to stand for twelve hours, the impurities removed by decantation, and the deflocculated clay substance then flocculated by addition to the suspension of sulphate of alumina. Compared with the deflocculator more than three times the quantity of flocculator, namely, 1½ oz., were required in order to throw down the clay. The clay, after drying, was put into a rubber mix (rubber, clay, and sulphur only), and it was found that the figures for breaking strain and tensile strength after vulcanisation were inferior to those given by the same clay when untreated and containing the original impurities. A comparison was also made between the removed impurities and the original clay, and showed that the former gave much lower figures than the original untreated clay, as was to be expected.

Eight lb. of the same clay were brought into suspension in the same quantity of water as before by addition of ½ oz. of pyrophosphate of soda and ¾ grams of resin. The suspension was left to stand sufficiently long for the impurities to settle out, and the clay was then flocculated by addition of only ¼ oz. of sulphate of alumina. This quantity of flocculator gave the same degree of flocculation as obtained by the 1½ oz. employed in the preceding experiment. The clay was dried and compounded with a rubber mixing as before, giving a vulcanised product of far superior physical properties to those of the first composition.

One lb. of the clay obtained according to the first experiment was examined for acidity, and was found to require for neutralisation four-tenths per cent. of sodium carbonate relatively to the clay. A quantity of the clay was then neutralised with the ascertained amount of sodium carbonate, dried and introduced into a rubber mixing. The physical properties of the product again displayed a marked improvement over those of the composition first prepared.

Like improved results were obtained when this clay, deflocculated as before, was flocculated with sodium carbonate or limewater.

The general effect of addition to vulcanisable rubber mixings of clay of the aforesaid lowered degree of acidity is to give not only an increased speed of cure, but, what is much more important, a valuable increase in the breaking strain and in the elongation at break of the vulcanised product. These properties are usually found to be markedly superior to those possessed by rubber compositions compounded with clay having the higher degree of acidity, consequent upon flocculation from its suspensions in the ordinary manner with powerful acids or their salts.

No. 4 Jetty

WE understand that the local authorities at Fowey are fully alive to the necessity of making greater efforts for the prompt loading of China Clay, and that special instructions have been issued that every facility shall be given producers, whilst repair work is being undertaken on No. 4 jetty, to facilitate the loading on other jetties. We believe that instructions have also been given that No. 4 jetty shall be completed within six weeks of the commencement of repairs. This news is of great importance to producers, and will be much appreciated by them, as showing that the G.W.R. authorities are still just as alive as ever to the importance of the China Clay export trade.

Coloured Glaze for Porcelain

As we are aware the "grand feu" or sharp fire decoration of hard porcelain involves a series of long and delicate operations. In the first place the colours must be fritted and then to obtain a good coloration the object must be fired several times. Thus, for example, Sèvres blue is laid on enamelled porcelain (therefore already fired at the ordinary temperature for porcelain) to be then passed through a muffle furnace and then a sharp fire. Thus the object must be fired two or three times, during several days. Besides consumption of coal and occupation of the kilns, labour is greater and the risk of breakage greater.

A recent French invention by Mr. P. H. M. Anquet (dated September 4, 1924) is a new method to colour hard porcelain without fritting and with less firing. He utilises a new composition consisting of pegmatite, silica, China Clay and chalk in certain proportions, whereas the glaze for hard porcelain is always pure crushed felspar. This glaze colours less easily than the composite glaze.

Then the inventor adopts a new method of work, mixing the glaze cold with water and natural colours without fritting. The new glaze thus coloured is applied to the crude or biscuit baked object and the colour developed by a single firing as oxidising as possible.

In the first place a colourless glaze is made by crushing, and blending in water, without melting, pegmatite, silica (quartz sand), China Clay and chalk.

Pegmatite	25½ to 30 parts
Silica	30 ,,
China Clay	20 ,,
Chalk	24 to 26 ,,

According to the percentage of silica and alkali in the pegmatite the proportion of lime is increased or decreased, employed in the form of calcium carbonate (chalk) to raise or lower the degree of fusibility.

Pulverised natural oxides, in suitable proportions, are then mixed in water with this glaze, by any mechanical method and as uniformly as possible. No fritting is necessary for these natural oxides.

The fundamental colours are made as follows :—

Blue	Glaze	100
	Black Cobalt Oxide	5

By varying the percentage of cobalt oxide 0·25 to 5 per cent. more or less deep blues are produced.

Yellow (with reddish tint)	Glaze	100
	Colcothar	4·5
	Ruttle	9
Beige (raw)	Glaze	100
	Colcothar	2·25
	Rutile	9
Chestnut (slightly Crystalline)	Glaze	100
	Colcothar	8·8
	Rutile	8·8
Green	Glaze	100
	Black Cobalt Oxide	10 to 5
	Rutile	15 to 7·5
Violet	Glaze	100
	Rutile	5·5
	Colcothar	5·5

All these mixtures are made without fusion and with these funamental colours the tints can, of course, be varied indefinitely, by suitable mixtures.

Moreover, the addition of 15 to 20 per cent. zinc oxide to one of these coloured glazes, except blue, sometimes gives pretty crystallisations and absolutely unexpected tints.

For example, the following glaze:

Glaze	100	+20 per cent. zinc oxide
Rutile	8·8	
Colcothar	8·8	

is quite dull and crystallised in places. Greens remain more brilliant. If the known frit is added to these glazes—

Frit	Quartz Sand	54·50	per cent.
	Potassium Carbonate (dry)	21	,,
	Zinc Oxide	24·50	,,

and in the proportion of:

For Blue	100	per cent.
Beige (raw)	50 to 60	,,
Yellow	50 to 60	,,
Chestnut	50 to 55	,,
Green	100	,,

well glazed colours are produced with infinitely varying tints according to the proportion of frit. These colours crystallise in slow cooling.

The following glaze—Glaze 100, Rutile 14·55, Colcothar 9·95—gives a completely crystallised golden brown. The glaze is laid cold with water on the crude or biscuit porcelain, by known methods—*i.e.*, with a brush, by insufflation or dipping. All that remains is a single firing which should be in as oxidising an atmosphere as possible, especially when the glaze contains zinc oxide and firing is stopped at cone 13. The colours are as pure as those given in the ordinary methods and cost is clearly less owing to the considerable amount of time and fuel saved.

The Purpose of Fillers

A FILLER is any substance which is so finely divided that it fills up the spaces between the fibres composing the sheet of paper. However, common usage in book and writing mills has limited the meaning of the word to such an extent that to the practical superintendent it means a white, grit-free mineral substance which can be obtained at a low cost. The only materials which answer these requirements at the present time are English clay, American clay, talc, blanc fixe, anhydrous sulphate of lime, crystallised sulphate of lime, and carbonate of lime. These materials have different physical and chemical properties which cause them to give different characteristics to the paper in which they are used. To ascertain the types of fillers best suited to given purposes, it is necessary to understand the mechanics of their action in the paper, for their action is almost entirely mechanical. The fibres composing the sheet are porous, and lie in a tangled mat which gives rise to relatively large spaces between the fibres. It is thus evident that if a more or less solid-surfaced sheet is desired, a filler must be used which will not only fill up the spaces between the fibres, but also the spaces within the pores of the fibres themselves. This apparently leads to the conclusion that one of the fundamental characteristics of a good filler should be a sufficient range in particles as will fill up the largest spaces within the sheet. Other less important but more widely recognised characteristics of a good filler are : (1) a bright white colour ; (2) freedom from dirt and grit ; (3) low solubility in water ; (4) freedom from chemical action from alum ; (5) freedom from effect on sizing ; (6) absolute uniformity ; (7) low cost.

China Clay at Wembley

CHINA CLAY is represented in various forms at Wembley, but it is rather surprising that with all the opportunities offered for bringing China Clay to the notice of the millions of visitors who might be interested in it, not one China Clay firm is represented in the Palace of Industry.

The chief exhibits of English China Clay, china stone, ball clay and felspar are in the minerals section of the Government Building. Here are to be seen specimens sent by English China Clays, Ltd., Varcoes China Clays, Ltd., H. D. Pochin and Co., Ltd., and Dartmoor China Clay Co., Ltd. In addition to being represented in the specimens exhibits, the last-named company has an interesting separate exhibit which "tells a story." Here they not only show specimens of their clays for various purposes, but show samples of the articles in which their products enter, such as china ware, paper, rubber and so on. Further they show specimens of colloidal clay and the appearance of this clay when dyed various colours. A number of enlarged photographs of the Dartmoor Co.'s works decorate the walls, together with a diagram in the form of a tree showing the many products in which China Clay is employed. Some such exhibit on a larger scale undertaken by the industry as a whole in the Palace of Industry would have been an excellent piece of publicity for the trade. On the limited scale the Dartmoor Co. have laid out their exhibit, and it is an interesting piece of publicity. In the Malaya Building, a Malayan China Clay Co. has a large exhibit of the native product, and some specimens of pottery, including insulating china used in the electrical trade, made from the clay. Its value as a potting material is emphasised, but apparently no claim is made for it as a bleaching or paper-making agent. In the same pavilion is a large exhibit of crude rubber and rubber products. Amongst the latter, the mixtures used in road-making rubber specialities are interesting, as are also

the mixtures, which include China Clay, in other rubber manufactures.

Percentages of China Clay in Paper

Another exhibit of particular interest to China Clay producers is the paper-making machine in the Palace of Industry which has been worked making paper by a different firm every week the Exhibition has been on. The two weeks I paid visits cream laid writing paper was being made, the first week by John Tod and Son, Ltd., of Lasswade, Scotland, and the second week by East Lancashire Paper Mill Co., Ltd., Radcliffe, Manchester. Mr. John D. Tod, who represents the third generation of his family engaged in the paper-making trade, very readily showed me the intricacies of the machine, from the beating vat containing all the ingredients, to the end of the machine where the finished paper dried and calendered was rolled on a cylinder. He told me that they were using 10 per cent. China Clay in the cream laid writing paper then being made, but in super-calendered paper, such as imitation art and real art papers used by such publications as *The Sphere* and similar high-class productions between 30 and 40 per cent. China Clay is employed. His firm, Mr. Tod told me, do not make "news," but he said probably between 12 and 15 per cent. China Clay was employed in that class of paper. Next month I hope to give *China Clay Trade Review* readers some further interesting information about the paper-making industry of the United Kingdom which I gleaned from experts at the Exhibition.

S. P. B.

China Clay Hydraulics

HYDRAULIC engineers have been applying themselves to the investigation of the problem of working China Clay pits hydraulically and have come to the conclusion that it involves two distinct phases says *The Quarry and Surveyors' and Contractors' Journal*. Firstly, hydraulic working virgin soil with plant following the gradually sinking pit bottom, and secondly, hydraulic working on lowest level, mining away on approximately horizontal plane. During the first period it is considered best to use an electrically operated centrifugal pump designed for pumping the mixture of water, clay and sand set in motion by the hydraulic jets operated from a suitable nozzle pump arranged on bank level, the latter pump to draw in the usual way from the clay settling basin. This sand pump would lift the mixture of clay, water and sand from the pit bottom up to the paddock on the bank. Here another centrifugal pump would receive the clay and water and lift it up to the settling tanks, the sand having previously been removed in the paddock or hopper boxes. This procedure would advantageously be adopted down to a depth of the pit bottom of, say, 30 ft. or thereabouts. Now the paddock, or paddocks, would be lowered to and rigged up at this intermediate level while the sand pump feeding these boxes would again follow the sinking pit bottom until, say, 60 ft. below tank level. Should the mine require still further lowering, the paddock would now be lowered to, say, 60 ft. from bank. The sand pump would follow the further sinking pit bottom and so forth. From the paddocks the waste sand would be hauled by trolley or aerial ropeway to the sand dump.

Sand Pump v. Trolley

Bearing in mind that the sand pump is less efficient than the clay water pump and considerably less efficient than trolley transport, it is obvious that an appreciable saving would be effected as compared with schemes involving sand pumps designed for lifting during the whole period of sinking from pit bottom to a paddock situated on bank. In addition, the life of the sand pump is increased very considerably, due to this reduction in total lift (or pressure), while the life of the clay water pump is not adversely affected to any appreciable extent. Against the method recommended above would have to be charged the cost of lowering the paddock, say, twice, by 30 ft. each time, but it is considered that the net result would be a distinct saving of money. Incidentally, the original cost and the weight of the sand pump, its motor and hut would be reduced substantially. The removal of the plant during sinking operations would thus be facilitated. In order to obviate the use of a sand pump, the paddock boxes can be lowered continuously along the sinking pit bottom, rigging them up sufficiently low to permit of the tailings being gravitated from the face washed by the hydraulic nozzle.

Although wear and tear of the sand pumps is necessarily rather high, the wages spent on lowering and rigging up the cumbersome paddocks so frequently would exceed the cost of renewals of the sand pump materially.

Hydraulic Work on Lowest Level

When the mine has reached its maximum depth, that is, when hydraulic operations are carried out on about constant level, thus widening the pit radially, the system recommended is paddocking the sand at pit bottom, raising it by trolley or aerial ropeway, and pumping the clay and water from which the sand has been separated in the paddock straight up to the clay settling basins. Thus the sand pump, which must always be subjected to considerable wear, is done away with. The same system would certainly be recommended for work during the first period as well were it not for the large amount of work requiring to be spent upon the frequent removal of the paddocks.

Whether a Cornish or centrifugal pump be used for dealing with the sand does not affect the question of wear materially. As to the capacities of sand, clay and nozzle pumps, the larger they can be made the better, both in regard to efficiency and wear of the individual machines. Factors that operate in deciding on hydraulic China Clay working are local conditions, such as size of settling basins, size of drying plant, and the question of continuous work at the pit—matters which have, of course, to be considered individually in every case. With reference to the pressure at which the hydraulic jet should be operated, it is not possible to give a hard and fast rule, as it naturally depends upon the nature of the ground treated. For most cases it is safe to provide for an effective pressure of 90 to 110 lb. per sq. in., measured at the nozzle.

The Hospital Finances

Feared Sequel to Dissolution of Association

AT the annual meeting of the St. Austell Cottage Hospital on October 10, the Hon. Treasurer (Mr. H. Stocker, a director of English China Clays, Ltd.), commenting on the increase of contributions from the China Clay works by £96 to £266, said it had given them a good lift up and was accounted for by the improvement in the China Clay trade in the last two or three years, but now they were passing through a period of depression consequent upon the dissolution of the China Clay Association, and there was every possibility that the contributions from clay works would fall off in the coming year. Though they had a balance on the last year's working, Mr. Stocker warned the public of this possibility, and also pointed out that the extensions, to cost £3,000, would involve greatly increased cost of maintenance, so that any relaxation of effort would be a mistake.

Mr. J. W. Higman (who was one of the managing directors of the China Clay Association) emphasised the seriousness of the dissolution of the Association to such charitable institutions as the Hospital, and remarked that when the annual report was drawn up such disastrous consequences of the break-up of the Association were not anticipated. The report submitted by the Honorary Secretary (Mr. G. H. Grenfell) showed that the expenditure for the year amounted to £1,922 against £1,770 income. Of the 292 patients dealt with during the year, 280 were discharged cured. There were 282 operations.

Mr. E. B. Vian was elected chairman in the place of Mr. H. Hodge, who had been chairman for many years, Mr. J. W. Higman was elected vice-chairman, and the treasurer and secretary were re-elected. Sir Francis Layland-Barratt was again re-elected President. Mr. Martin F. Hitchins was added to the Executive Committee, he having resigned from the joint secretaryship. Mr. Hitchins is a director of English China Clays, Ltd.

China Clay Notes and News

Clay Workers' Champion Band in London

Though making a plucky third attempt, St. Dennis Band failed again to get into the prize list at the Crystal Palace Nineteenth Band Festival on September 22, they only narrowly missed it by receiving fourth place. They competed in the Grand Shield contest.

In the Grand Shield contest last year there were 26 bands competing, and St. Dennis had the handicap of being last in the draw. By an extraordinary turn in the wheel of fortune this year they had the luck of being drawn first, thus being deprived of the opportunity of first hearing other bands and settling down to the contest temperament before they were called upon to occupy the stand. Nevertheless, they put up a first-rate performance and put their very best into the playing. It costs, roughly, £200 for St. Dennis to compete at the Crystal Palace, the money being raised apart from the general Band Fund. It reflects great credit upon all who by their efforts in securing this large sum of money have made it possible for the Cornish champions to compete a third time. Prominent amongst these must be mentioned Mr. John Hooper, the Chairman of the Committee; Mr. J. Best, Hon. Secretary; Mr. R. Hooper, Hon. Treasurer; and Mr. F. S. Liddicoat, a committee man, who were amongst the party who made the arrangements for the band's visit. The whole party numbered nearly 50, but the fund was only responsible for the expenses of the 26 comprising the Band.

In the evening the band attended the London Cornish Association's concert at the Cannon Street Hotel, where the Cornish exiles gave the band a great reception. Their contributions to the programme were the test piece, "Oliver Cromwell," "The Military Church Parade," and the hymn tune "Plain an Gwarry." Mr. W. H. Gorgenven presided, and voiced the delight of the audience in having in their presence their beloved county's champion band.

The Band's visit to London covered five days, for three of the four working days their employers generously paying them. Most of the men are employed by Messrs. H. D. Pochin and Co., Ltd., others being drawn from the works of English China Clays, Anchor United and Great Treviscoe. The readiness with which the companies grant the facilities which enable the band to compete are greatly appreciated by the band and committee, of which the Hon. H. D. McLaren is the president.

Associated China Clays, Ltd.—Winding Up Confirmed

An extraordinary general meeting of the Associated China Clays was held on Thursday, September 25. The Hon. H. D. McLaren presided, and there were also present Messrs. T. Medland Stocker, R. Martyn, J. W. Higman, G. S. Richards, S. J. Dyer, J. Perry, J. Hooper, E. J. Hancock, F. Parkyn, W. Wedlake, J. Haworth, M. Stocker, W. Lovering, J. Lovering, C. V. Rowe, J. Tonkin (representing Great Treverbyn Co.), J. Rogers, Hart Nicholls, Walter Sessions, H. S. Pochin, D. T. Taylor, and S. Benson, secretary.

The Chairman explained that the meeting was called as the outcome of the decision arrived at at the previous board meeting to pass the necessary legal resolution for winding up the company. Personally, and he believed the managing directors and all the members of the Association except one would agree with him when he said they all regretted the dissolution of the Association. They believed the company was a great benefit to the producers, to the men in their employ, and to Cornwall generally, and they regretted its termination, but the continuance of an arrangement depended to a very large extent on members being willing to co-operate for the general good of all, but if certain firms thought they were justified in staying outside or going outside or breaking the rules of the Association in order that they might get a greater share of the gain at the expense of other members of the trade, then such an Association could not be carried on. He would like to say that he had hopes that it was only a temporary disturbance and that the Association, comprising members present, could be reformed, but he could not himself hold out any hopes that that would be the case. Concluding, Mr. McLaren thanked the members for the loyal way in which they had supported him as chairman of the Board.

Mr. T. Medland Stocker said it was with great regret that he proposed as a resolution that the company be wound up voluntarily. Nobody regretted the decision more than he did. Mr. J. Lovering seconded what he termed a regrettable resolution. The resolution on being put was carried *nem. con.*

Link with China Clay Pioneer Days

The death of Miss Roxana Stocker, which occurred at Newquay last month, has removed an interesting link with the China Clay industry. Miss Stocker, who was in her 84th year, resided for many years at Glenview, St. Austell, with her sister, the late Miss Ann Stocker, who died at St. Austell only a few weeks previously. Both were associated with the St. Austell Baptist Church and Sunday School, and the Connexion have been bereft of two very generous supporters. Their combined ages were considerably over 170 years. They were daughters of the late Mr. Edward Stocker, and sisters of the late Mr. Tom Stocker, of Glenview, and Mr. Edward Stocker, of Rosemorran, St. Austell. Their father was one of the earliest pioneers of the China Clay industry, and was one of the first in the town to possess a trap, with which he used to visit the clay works in the neighbourhood of St. Stephens. The first visit the late Mr. Edward Stocker made at Foxhole, Nanpean and St. Stephens aroused intense interest and crowds came for miles to see this innovation.

The funeral took place in the St. Austell cemetery amid evidence of general sympathy, and the officiating ministers were the Rev. Durban, of Exmouth, a prominent minister of the Connexion, and friend of the family, and the newly appointed pastor of St. Austell Baptist Church, the Rev. A. N. Nicholson. The mourners were Major E. G. Stocker, Mr. T. Medland Stocker, J.P., Mr. Harry Stocker, Mr. E. S. Weekes, Dr. Shaw, Mr. G. H. Grenfell, Mr. H. Martyn, (nephews), Mr. E. Searle, Mr. W. P. Northey, Mr. W. C. Truscott, Mr. H. Rowse.

The Rev. Durban, in an address, referred to the great loss sustained by the Church and Connexion and the town generally. A memorial service was held in the St. Austell Baptist Church.

China Clay Workers Demand Increased Wages

Following hard upon the China Clay crisis due to the dissolution of Associated China Clays, Ltd., yet another crisis is pending in the form of an application from the Workers' Union for an increase in wages and other alterations in the working conditions of the China Clay industry. The application is being made with the view to drafting a new working agreement, the old agreement having ended in June, 1922, no agreement having been in existence since that date. At the time, interest in the Workers' Union dwindled to a minimum, but there has recently been a revival of the Union, a good many of the employees at several of the clay works, where meetings have been held, having rejoined at the instigation of the employees.

We understand that an increase of 3d. per hour is to be asked for, which would bring the present rate up to 1s. 3d. per hour. This would mean a minimum wage for a 42-hour week of £2 12s. 6d., as compared with the present rate of £2 2s. This rate applies to day workers only who are engaged in the most unskilled work in the pits. A large proportion of China Clay workers are employed on piece work and earn substantially higher wages. The China Clay Employers' Federation met at St. Austell to consider the application on October 3, and referred it to the Joint Industrial Council of the industry.

To be faced with such a demand now that there is such keen competition in the China Clay market—clays being offered at cut-throat prices and in some cases below the actual cost of production, the China Clay producers are confronted with a problem of immense gravity. The granting of an increase in wages at the present time would almost certainly mean a curtailment of the number employed in some of the works, while in the case of the smaller works, where production costs are already excessively heavy, there is the possibility of some pits closing down.

China Clay Worker J.P.'s

Included in a group of 22 new magistrates appointed to various Cornwall benches, are two China Clay workers employed by English China Clays, Ltd.

"Captain" Walter Light is the better known and has been a prominent public man in the St. Stephens district for many years. He is responsible for the drying and loading of his firm's numerous grades of clay. Born in Devon in 1866, he was one of a family of 14, whose father died a few weeks ago at Lee Moor, Devon, at the age of 95. "Captain" Light's early days were spent on a farm, and he had only six months education at a Board school. At 15 years of age he joined the Navy, and saw considerable service in the Mediterranean, taking part in the bombardment of Alexandria, and helped to fit out boats for the Nile Expedition. While in the Service he gained a reputation as a boxer, and in 1886-87, he held the Mediterranean Naval championship, and in 1890 the amateur boxing championship of Plymouth Harbour. In 1891 he left the service with the rank of petty officer instructor, owing to ill-health.

He migrated to Cornwall in 1895, and settled at Foxhole. He has always taken a keen interest in the welfare of St. Stephens parish. For over 20 years he was a member of the Parish Council, and retired three years ago, after having been chairman for many years. He is a well-known local preacher, connected with the St. Austell United Methodist Circuit.

For many years "Captain" Light was a member of St. Austell District Education Committee, and is one of the oldest members of St. Stephens group of school managers. During the war he rendered yeoman service in recruiting, and raised labour battalions for Woolwich and for France, in addition to which he installed hundreds of Cornishmen in the iron mines of Lincolnshire and Northamptonshire for the Ministry of Munitions. Later he was a zealous member of the Food Control and War Pensions Committees.

"Captain" Light has been an active Liberal all his life, and during every election rendered magnificent service to his party. He is a member of Penryn-Falmouth Liberal Executive. During the last few years under his inspiring leadership, Foxhole Institute has been built and Foxhole Recreation Ground enclosed.

Mr. Clarence Ray Minnear, the other new magistrate, is a China Clay works blacksmith at English China Clays, Ltd., Meledor works. He is a Liberal. For many years he has been prominently associated with the Brotherhood movement. He is actively associated with the United Methodist Church at St. Stephens, where he is choirmaster. He is the brother of the Rev. G. E. Minnear, United Methodist Minister at St. George's Church, Truro.

Fowey China Clay Jetty Fatality

A fatal accident, a rare occurence at Fowey Jetties, happened there on October 8. William Henry Pattison, 43, employed as an electrician on the Great Western Railway Electrical Department, had his right arm torn from his body by the jockey pulley of the electric crane conveyor at No. 4 Jetty, in which it had got caught.

Mr. W. Cooke rendered first-aid, and the injured man was conveyed with all speed to the Cottage Hospital, where, though he was attended by Doctors King and Jay, of Fowey, he died from his terrible injuries.

Flood Damage to Clay Works

Considerable damage was done in the St. Austell District by a violent storm that swept over Cornwall on the night of October 7. Torrential rain fell for several hours and so flooded the rivers that in many places they burst their banks, low-lying roads like Par Moor, Gover Valley, Bodmin Road, and Pentewan Road lying close to the clay-rivers being under water to a depth of one to two or three feet and dangerous for traffic, some houses being also flooded. Considerable damage was done in several China Clay works, especially Mica Clay works, whose plant is laid out alongside the rivers. In Gover and Bodmin Roads, river hatches, bridges and weirs were swept away, mainly through the openings being blocked with branches of trees and undergrowth which dammed back the water until the pressure became so great that the foundations gave way and carried the structures with them. Considerable expenditure will be involved in restoring them.

At Pentewan the White Clay River overflowed its banks. The main road to St. Austell was under water—the G.W.R. Mail bus being unable to call at the village on its way to Mevagissey and Gorran. Several of the houses were flooded, and but for the fact that it was low tide at the time the whole of the lower part of the village would have been under water. As it was some people had to use their bedroom windows as the means of exit from their houses.

The pits at Ruddle Common and Trethowal Clay Works, among others, were badly flooded, the pumping gear being under water. Other works suffered severe damage owing to the heavy rain rushing in streams over the stops and carrying overburden with them. At Trethowal the course of the White River was diverted into Bodmin Road through debris blocking up the course of the river, the roadway and houses adjoining being flooded with clay water. Such a water spout, which lasted for hours, has not been known in the district for a great number of years. The damage to clay works was so extensive as will take hundreds of pounds to repair. The flooding of the pits took days to unwater.

American Visitors

This month has seen a number of U.S.A. visitors, interested in China Clay, in London and Cornwall. Mr. Westlake, President of the Perkins Goodwin Co., Mr. Goldman, of English China Clays Sales Corporation, both of New York, have been here, as also has Mr. Marks, and many others. No doubt the break-up of the Associated China Clays, Ltd., has had something to do with their visits. Most Americans like a trip to Europe, but I guess they prefer to live in "God's own Country" best.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that occur.

Mortgages and Charges

*[NOTE.—The Companies Consolidation Act, of 1908, provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]*

CENTRAL CORNWALL CHINA CLAY CO., LTD., St. Blazey. Registered October 1, £50 debentures, balance of £25,000; general charge; also registered October 1, £10,000 debentures (filed under section 93 (3) of the Companies (Consolidation) Act, 1908), present issue £5,150; general charge. *£24,950. May 1, 1924.

COOKE (HENRY) AND CO., LTD., Richmond (Yorks), paper manufacturers. Registered September 13, £7,000 (not exceeding) debentures, to S. Robinson, 26, Newbiggin, Richmond (Yorks), draper, and others; general charge. *Nil. July 16, 1924.

SMITH STONE AND KNIGHT, LTD., Birmingham, paper manufacturers. Registered September 3, £6,600 debentures, part of £50,000; general charge. *£43,400. January 17, 1924.

Satisfaction

PORTALS, LTD., Whitchurch (Hants), paper manufacturers. Satisfaction registered September 16, £30,000, registered May 23, 1922.

London Gazette, &c.

Company Winding Up Voluntarily

KERROW AND ENNIS CHINA CLAY CO., LTD. Violet Gweneth Hurst, 85, London Wall, London, E.C., appointed liquidator, September 24.

Shipping and Export News of the Month

We give below the latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—September, 1924

Arrived		Name	Sailed	Destination
Sept. 1,	S.S.	*Cervantes*	Sept. 4,	Genoa
Sept. 1,	M.V.	*Theodora*	Sept. 1,	Mevagissey
Sept. 1,	S.S.	*Amy Summerfield*	Sept. 5,	Preston
Sept. 2,	M.V.	*Shamrock*	Sept. 3,	Plymouth
Sept. 3,	S.S.	*Stertpoint*	Sept. 5,	Bristol
Sept. 3,	S.V.	*Hippen*	*	Genoa
Sept. 3,	TUG	*Donau*	Sept. 3,	Rotterdam
Sept. 3,	S.S.	*Katherine*	Sept. 3,	Plymouth
Sept. 3,	M.V.	*Diligent*	Sept. 3,	Pentewan
Sept. 3,	M.V.	*Theodora*	Sept. 3,	Mevagissey
Sept. 4,	S.V.	*Helena Anna*	*	
Sept. 4,	S.S.	*Essonite*	Sept. 6,	Preston
Sept. 4,	M.V.	*Shamrock*	Sept. 5,	Plymouth
Sept. 4,	S.S.	*Pickavance*	Sept. 6,	Barrow
Sept. 4,	S.S.	*Brier Rose*	Sept. 8,	Manchester
Sept. 6,	S.V.	*Ansgar*	Sept. 14,	Leith
Sept. 5,	S.V.	*Mary Barrow*	Oct. 1,	Charlestown
Sept. 5,	S.S.	*James Tennant*	Sept. 6,	Brussels
Sept. 6,	S.S.	*Clydevalley*	Sept. 10,	Weston Point
Sept. 7,	S.V.	*Thora*	Sept. 22,	Sandviken
Sept. 7,	S.S.	*Kenrhos*	Sept. 10,	Seville
Sept. 7,	M.V.	*Wigala*	Sept. 11,	Drammen
Sept. 8,	S.S.	*System*	Sept. 10,	Gravesend
Sept. 8,	S.S.	*Onyx*	Sept. 11,	Weston Point
Sept. 8,	S.V.	*Hilda*	Sept. 12,	Charlestown
Sept. 9,	S.S.	*Falmouth Castle*	Sept. 11,	Runcorn
Sept. 9,	S.V.	*Happy Harry*	Sept. 27,	Larne
Sept. 9,	S.S.	*Sacro Cuore*	Sept. 14,	Genoa
Sept. 9,	S.S.	*Evelyn Manor*	Sept. 12,	Leith
Sept. 9,	S.S.	*Broadgreen*	Sept. 13,	Bilbao
Sept. 9,	S.V.	*Annie Jones*	Sept. 19,	Gravelines
Sept. 9,	S.S.	*Shoreham*	Sept. 13,	Preston
Sept. 10,	S.S.	*Halton*	Sept. 13,	Liverpool
Sept. 10,	S.V.	*Hebe*	*	
Sept. 11,	S.S.	*Bengt*	Sept. 16,	Sarpsborg
Sept. 11,	S.S.	*Albert Mou*	Sept. 16,	Drammen
Sept. 11,	S.S.	*Ualan*	Sept. 16,	Antwerp
Sept. 11,	M.V.	*Vera*	Sept. 17,	Sundsvall
Sept. 11,	S.S.	*Pylades*	Sept. 15,	Methil
Sept. 11,	S.S.	*Berkelstroom*	Sept. 17,	Amsterdam
Sept. 12,	S.V.	*Alice Williams*	Sept. 19,	Par
Sept. 12,	S.V.	*Emily Warbrick*	*	Runcorn
Sept. 12,	S.S.	*Poelcappelle*	Sept. 19,	Terneuzen
Sept. 13,	S.V.	*Olive Branch*	*	Runcorn
Sept. 13,	S.S.	*Eastern City*	Sept. 26,	Philadelphia
Sept. 13,	S.S.	*Whinhill*	Sept. 16,	Liverpool
Sept. 13,	S.S.	*Jomsborg*	Sept. 44,	Kotka
Sept. 13,	S.S.	*Sten Sture*	Sept. 19,	Helsingborg
Sept. 15,	S.S.	*Ravenspoint*	Sept. 19,	Genoa
Sept. 15,	S.S.	*Maindy Grange*	Sept. 26,	Portland and New York
Sept. 15,	S.S.	*Galtee*	Sept. 24,	Weston Point
Sept. 16,	M.V.	*William John*	Sept. 18,	Truro
Sept. 16,	M.V.	*Theodora*	Sept. 16,	Plymouth
Sept. 16,	S.S.	*Hayle*	Sept. 20,	Ridham
Sept. 17,	S.S.	*Katherine*	Sept. 18,	Plymouth
Sept. 17,	S.S.	*Saint Andrew*	*	Boston and Philadelphia
Sept. 18,	S.S.	*Farfield*	Sept. 24,	Antwerp
Sept. 18,	S.S.	*Isabeletta*	Sept. 23,	Larne
Sept. 18,	S.V.	*Isolda*	*	Gothenborg
Sept. 18,	S.S.	*Susetta*	Sept. 24,	Preston
Sept. 18,	S.S.	*Ferndene*	Oct. 1,	Antwerp
Sept. 19,	S.S.	*Industria*	Sept. 25,	Rouen
Sept. 19,	S.V.	*De Ruyter*	*	Harburg
Sept. 19,	S.V.	*Mary Sinclair*	*	Weston Point
Sept. 19,	S.S.	*Latamise*	Sept. 25,	Greenhithe
Sept. 19,	S.S.	*Ewy*	Sept. 26,	Fredrikshald
Sept. 19,	S.V.	*Julia*	*	
Sept. 20,	S.V.	*Mary Ann*	*	Weston Point
Sept. 20,	S.S.	*Mary Aiston II*	Sept. 25,	Gravelines
Sept. 20,	S.S.	*Rival*	Sept. 27,	Kotka
Sept. 21,	S.S.	*Calluna*	*	Brussels
Sept. 21,	S.S.	*Bruxelles Maritime*	Sept. 27,	Brussels
Sept. 22,	S.S.	*Pontypridd*	*	Boston and Portland Maine
Sept. 22,	S.S.	*Abington*	Sept. 27,	Liverpool
Sept. 23,	S.S.	*Falmouth Castle*	Sept. 29,	
Sept. 23,	S.S.	*Porthcarrack*	Sept. 1,	Runcorn
Sept. 24,	S.S.	*Lake Wood*	Sept. 1,	Pasages
Sept. 24,	S.V.	*Esther*	*	Norrkoping
Sept. 25,	S.S.	*Cromwell*	*	Weston Point
Sept. 27,	S.S.	*Katherine*	Sept. 27,	Pentewan
Sept. 27,	S.V.	*Kongedybet*	*	Odense
Sept. 27,	S.S.	*Claretta*	*	Liverpool
Sept. 28,	S.S.	*Trader*	*	Sunderland
Sept. 28,	S.V.	*Thor*	*	Copenhagen
Sept. 28,	S.S.	*Stanley Force*	*	Liverpool
Sept. 28,	M.V.	*Jenny Naval*	*	Harburg
Sept. 28,	S.S.	*Neutraal*	*	Pasages
Sept. 29,	S.V.	*Adelaide*	*	
Sept. 29,	S.V.	*Guiding Star*	Sept. 30,	Mevagissey
Sept. 29,	S.V.	*Rothersand*	Sept. 30,	Par
Sept. 30,	S.S.	*Ortona*	*	Antwerp

* Signifies "in Port."

Charlestown Shipping—September, 1924

Arrivals

Date	Vessel	From
Sept. 1	*Coniston*	Rouen
Sept. 3	*Vilborde Maritime*	Truro
Sept. 3	*Reedness*	Truro
Sept. 3	*St. Austell*	Penryn
Sept. 3	*Desag I.*	Kotka
Sept. 6	*Lady Daphne*	Rochester
Sept. 6	*Waterwitch*	Falmouth
Sept. 9	*Pursuit*	Fowey
Sept. 13	*Snow Queen*	Plymouth
Sept. 16	*Treleigh*	
Sept. 17	*Edenside*	Porthleaven
Sept. 18	*Magrix*	Truro
Sept. 18	*Nancie Thomas*	Goole
Sept. 19	*Lady Rosebery*	Plymouth
Sept. 26	*Condor*	Poole

Sailings

Date	Vessel	Destination
Sept. 3	*Coniston*	Rouen
Sept. 5	*Vilborde Maritime*	Brussels
Sept. 9	*Madeleine*	Nantes
Sept. 5	*Reedness*	Antwerp
Sept. 9	*St. Austell*	St. Malo
Sept. 12	*Waterwitch*	Runcorn
Sept. 14	*Lady Daphne*	Rochester
Sept. 15	*Pursuit*	Goole
Sept. 15	*Snow Queen*	Manchester
Sept. 17	*Treleigh*	Preston
Sept. 18	*Edenside*	Antwerp
Sept. 19	*Magrix*	London (Gravesend)
Sept. 19	*Nancie Thomas*	Manchester
Sept. 27	*Hilda*	London
Sept. 28	*Lady Rosebery*	Rochester
Sept. 30	*Condor*	Antwerp

Par Harbour Shipping—September, 1924

Arrivals

Date.	Vessel.	From
September 1,	S.S. *Katherine*	Plymouth
September 3,	S.V. *Eclipse*	Port Houstock
September 3,	S.V. *Yealm*	Plymouth
September 3,	S.S. *Ravenscraig*	Portleaven
September 3,	S.V. *The Sirdir*	Plymouth
September 3,	S.V. *Shortest Day*	Plymouth
September 3,	S.V. *W. E. Gladstone*	Port Houstock
September 4,	S.S. *Magrix*	Teignmouth
September 4,	S.V. *John Sims*	Garston
September 4,	M.V. *Regina*	Plymouth
September 5,	S.S. *Andalusia*	Hayle
September 5,	M.V. *May Blossom*	Plymouth
September 5,	S.V. *Margarette Est*	Shoreham
September 5,	S.V. *Louise*	Penarth
September 9,	S.V. *Gerd*	Douglas
September 9,	S.V. *Englishman*	Falmouth
September 10,	S.S. *Braedale*	Penzance
September 10,	S.V. *Snowflake*	Runcorn
September 10,	S.S. *Katherine*	Penryn

September 11,	S.V.	*R. Passmore*	Polperro
September 12,	S.V.	*Ivy*	Port Houstock
September 12,	S.V.	*Alice Williams*	Mousehole
September 12,	S.V.	*Ada*	Port Houstock
September 12,	S.S.	*Christiania*	Looe
September 18,	S.S.	*Tanny*	Truro
September 19,	S.S.	*Robrix*	Teignmouth
September 19,	S.V.	*Gertrude May*	Plymouth
September 20,	S.V.	*Two Sisters*	Truro
September 27,	M.V.	*Katie*	Rochester
September 27,	S.S.	*Pamela*	Penryn
September 28,	S.S.	*Rose*	Shoreham
September 28,	S.V.	*Winifred*	Port Houstock
September 28,	S.V.	*J. N. R.*	Port Houstock
September 28,	S.V.	*Gwendoline*	Port Houstock
September 30,	S.V.	*Rothersand*	Cardiff
September 30,	S.S.	*Ferrum*	Cowes

Sailings

Date.		Vessel.	Destination.
September 2,	S.V.	*Paquerette*	Rochefort
September 2,	S.S.	*Katherine*	Pentewan
September 3,	M.V.	*Hanna*	London
September 3,	S.V.	*Lucy*	Pentewan
September 3,	S.S.	*T. P. Tilling*	Preston
September 4,	M.V.	*Katie*	London
September 4,	S.V.	*Ycalm*	Pentewan
September 4,	S.S.	*Ravenscraig*	Tayport
September 5,	S.V.	*Shortest Day*	Pentewan
September 5,	S.S.	*Magrix*	Grimsby
September 5,	M.V.	*Regina*	Pentewan
September 9,	S.V.	*Bulla*	London
September 10,	S.V.	*Eclipse*	Pentewan
September 10,	S.V.	*The Sirdir*	Pentewan
September 10,	S.V.	*W. E. Gladstone*	Plymouth
September 10,	M.V.	*May Blossom*	Plymouth
September 11,	S.S.	*Andalusia*	Grimsby
September 11,	S.S.	*Katherine*	Pentewan
September 13,	S.S.	*Bracdale*	Ternussen
September 14,	S.V.	*John Sims*	Runcorn
September 14,		*Louise*	Bristol
September 14,	S.V.	*Gerd*	Leith
September 14,	S.V.	*Englishman*	London
September 16,	S.V.	*Alice Williams*	Western Point
September 17,	S.S.	*Christiania*	Preston
September 18,	S.V.	*Snowflake*	Runcorn
September 19,	S.V.	*R. Passmore*	Weston Point
September 19,	S.V.	*Ivy*	Queenborough
September 19,	S.S.	*Tanny*	Penarth
September 25,	S.S.	*Robrix*	Gravesend
September 28,	S.V.	*Gertrude May*	Rochester
September 30,	S.V.	*Ada*	Runcorn

Par Harbour Tide Table, October, 1924

(*Greenwich Meantime Throughout.*)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Wednesday	1	6.46	7.4	13.10
Thursday	2	7.23	7.43	13.7
Friday	3	8.5	8.25	13.0
Saturday	4	8.46	9.12	12.1
Sunday	5	9.35	10.5	11.1
Monday	6	10.39	11.19	10.6
Tuesday	7	—	0.4	10.4
Wednesday	8	0.49	1.34	11.1
Thursday	9	2.13	2.48	12.1
Friday	10	3.20	3.45	12.9
Saturday	11	4.11	4.34	13.2
Sunday	12	4.56	5.14	13.4
Monday	13	5.32	5.50	13.3
Tuesday	14	6.7	6.23	13.3
Wednesday	15	6.40	6.55	13.0
Thursday	16	7.10	7.25	12.7
Friday	17	7.40	7.56	11.11
Saturday	18	8.12	8.28	11.3
Sunday	19	8.45	9.4	10.8
Monday	20	9.25	9.51	10.1
Tuesday	21	10.22	10.56	9.8
Wednesday	22	11.38	—	9.9
Thursday	23	0.21	1.3	10.1
Friday	24	1.42	2.15	10.10
Saturday	25	2.45	3.12	11.8
Sunday	26	3.36	3.58	12.6
Monday	27	4.20	4.41	13.3
Tuesday	28	5.1	5.20	13.10
Wednesday	29	5.43	6.5	14.0
Thursday	30	6.26	6.46	14.1
Friday	31	7.6	7.27	13.9

E. CLEMENS, Harbour Master.

China Clay Exports

RETURN showing the exports of China Clay, including Cornish or China Stone, the produce or manufacture of the United Kingdom, from the United Kingdom to each country of destination registered during the month ending September 30, 1924:

Country of Destination.	Quantity.	Value.
Foreign.	Tons.	£
Finland	1,990	4,575
Latvia	450	880
Sweden	1,736	4,129
Norway	2,305	3,629
Denmark (including Faröe Islands)	3	24
Germany	473	1,038
Netherlands	4,223	9,536
Java	100	400
Belgium	3,421	6,349
France	3,341	7,258
Portugal	2	5
Spain	1,720	4,342
Italy (including Fiume)	2,467	6,387
United States of America	21,599	51,635
Mexico	85	340
Uruguay	3	22
Argentine Republic	2	12
Total Foreign Countries	43,920	100,561
British Possessions.		
Natal	—	4
British India (other ports)	969	3,871
Madras	60	240
Bengal, Assam, Bihar and Orissa	322	1,288
Australia—Victoria	10	43
New South Wales	12	63
Tasmania	—	1
New Zealand	1	8
Fiji Islands	—	4
Canada	2,310	5,465
Total, British Possessions	3,684	10,987
Total Foreign Countries and British Possessions	47,604	111,548

September Deliveries

THE clearance of China Clay stocks at cut prices, following the collapse of the China Clay Association in the middle of September, is reflected in the total trade done for the month of September, which came within 500 tons of the record month (April) for the year. From the point of view of prices, the clays sold, especially in the common clays class, since the dissolution of the Association, have undergone a very severe drop, resulting in, on the month as a whole, the least profitable period to the industry experienced since the Association started to function in January, 1918. The factor that has helped to swell the volume has been the clearance of some stocks, which have accumulated over a period of years, below cost, in order to make room for new productions. Now that these stocks have been liquidated, prices are likely to harden.

In the monthly totals given below it will be seen that the total increase of tonnage over the previous month was 12,313 tons, made up of an increase of 12,476 tons of China Clay, 1,372 tons ball clay, china stone having dropped 1,535 tons on the month. An analysis of the figures for the nine months ended September shows the substantial increase in total tonnage of 53,000 tons, made up of 31,549 tons China Clay, 12,268 ball clay, and 9,182 tons china stone.

Monthly Figures

Port.	China Clay.	China Stone.	Ball Clay.	Total.
	Tons.	Tons.	Tons.	Tons.
Fowey	56,218	4,358	3,009	63,585
Par	5,418	—	—	5,418
Charlestown	4,778	—	—	4,778
Plymouth	1,708	10	333	2,051
Penzance	850	—	—	850
Newham	418	—	—	418
By Rail	4,767	—	—	4,767
September totals	74,157	4,368	3,342	81,867
August totals	61,681	5,903	1,970	69,554

Nine Months' Figures

Comparative figures showing total deliveries for nine months, 1924 and 1923:—

China Clay.		China Stone.		Ball Clay.		Totals.	
1924	1923	1924	1923	1924	1923	1924	1923
591,646	560,097	39,909	30,727	28,454	16,186	660,009	607,001

The China Clay Trade Review

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Contents

PAGE
EDITORIAL NOTES 7–8
A Notable Paper Making Demonstration 9
China Clay Workers' Wages Settlement 11
The Action of Heat on Kaolinite and on Kaolinitic Clays 14
"Pine Pump-rods." By China Clay "Captain" 16
China Clay Notes and News 18
Shipping and Export News of the Month 19
Commercial Intelligence 20

New Markets for China Clay?

As a result of experiments made with certain Australian timbers to ascertain their suitability for paper making, a far greater interest is being taken by business people in the possibilities of placing the industry on a solid commercial basis. Paper is already being made in the Commonwealth, but the output is far below requirements. One group of investors has decided to enter the field and, as a first step, has acquired the extensive holdings of the Van Diemen's Land Company on the north-west coast of Tasmania Some very exhaustive tests have been made which have shown that paper can be successfully made from the eucalyptus wood, which particular type abounds in the area acquired.

A few years ago attention was given by a well-known company to the question of establishing works somewhere in Australia for the making of paper pulp out of local timbers, and prolonged inquiries and tests were made, with the result that Tasmania was decided upon, because its cheap power, easily accessible beds of timber, water supply, and climate gave the best opportunity for successful operation. Investigations showed that a mixture of two thirds of hardwood pulp with one-third of imported soft-wood pulp gave a very satisfactory result and would permit of the manufacture of paper on a commercial scale and at a substantial profit. At the time the matter was being considered, it was estimated that a capital of one million pounds would be sufficient to establish works to supply one-third of the requirements of Australian newspapers, leaving the other two-thirds still to be imported, but with the prospect of subsequently meeting the whole of the requirements of the Commonwealth. It is not only in Tasmania, however, that the prospects are good for the establishment of the paper making industry; other states have good timber areas, but some further tests are necessary before a start is made.

The most important result of the Tariff Board's inquiry concerning paper manufacture in India has been the exposition of the great potentialities of bamboo pulp. Although only one commercial enterprise is engaged in this field the scope is large, and it is believed that a widespread industry will arise, likely to rank in due course, among Indian industries, with jute and cotton. In a note to the Tariff Board, the experts at the Indian Forest Research Institute (Messrs. R. S. Pearson and W. Raitt) point out that bamboo has been admitted for 40 years to yield an excellent paper-making fibre in all respects but that of colour, but the cost of bleaching has hitherto checked any serious effort to exploit it. The problem of economical bleaching has, however, now been solved, and the large-scale experiments have actually yielded better results than the laboratory tests. Reduced to figures, the new processes mean that bamboo and grass pulps can be produced at 20 per cent. less than former costs, taking these up to the bleached stage. At present, in India, pulp and paper manufacture are conducted jointly. Utilisation of bamboo will permit their separation. Unlike grasses now used in Indian mills, supplies of which are scattered in small patches involving heavy freight charges, bamboo is found in solid, continuous blocks under excellent conditions of water transport from forest to pulp factory and sea transport of pulp from pulp factory to paper factory. The suitability of bamboo as fibre is established. The Titaghur mills at Calcutta during the war used very considerable quantities. They could not get the imported sulphite pulp, and so they had to use large quantities of bamboo, subsequently taking up concessions to assure their own supplies. Still more important is the experience with bamboo of the Indian Paper Pulp Co., an enterprise really started as a result of Government encouragement and as the first real attempt to manufacture pulp and paper on a commercial scale from bamboos entirely out of indigenous materials. This concern in the two years of its existence has gained valuable experience which confirms broadly the expectations which prompted its initiation. Approximately two and a quarter tons of bamboo are needed for one ton of unbleached pulp, and about one ton of unbleached pulp is required for one ton of finished paper, though it varies slightly in different classes of paper. The bamboo forests in India and Burma are probably sufficient to supply the whole world's demand for pulp. As these forests can be worked on a three years' rotation the supply is practically inexhaustible. Already there i in operation, fos ering the industry by propaganda and otherwise, an Indian Paper Makers' Association.

China Clay Trade Position

As was expected, there has been an increased volume of trade since the dissolution of the China Clay Producers' Association in the middle of September, but October is the first full month the industry has experienced free from the supervision of the Association.

The October figures are too late for analysis here, but the September returns showed an increased tonnage over the previous month of China Clay, 12,476; and ball clay, 1,372. China stone showed a drop of 1,535 tons. The actual figures were:—China Clay, 74,157 against 61,681 tons; ball clay, 3,342 against 1,970 tons; China stone, 4,368 against 5,903 tons.

The China Clay figures at any rate reveal the fact that buyers have not been slow to take advantage of the severe cut in prices since the Association was dissolved. Bargains have been snapped up with great avidity. The extra business done, however, has not been very profitable to the sellers; as a matter of fact, stocks in many cases have been cleared at below cost, while in others where a profit has resulted, it has been of a very narrow margin.

This applies chiefly to the clays of the common class, of which large stocks had accumulated, the object of firms in clearing them at below cost being to prepare the plant for the production of new stocks. So it is not likely the bargains the buyers have seized upon will be repeated,

though they will continue to make purchases at prices that will leave producers very little profit.

Therefore, while greatly increased tonnage is being dealt with, it is well to remember that the people engaged in producing the clay are not reaping extra benefit, but that they are working to put profits, which should belong to the industry, into the pockets of buyers who are taking the fullest advantage of the anticipated price-cutting war that has followed upon the collapse of the safeguard for the industry that the Association offered.

There is this to be said, by way of consolation, that buyers will never again have such opportunities for acquiring quantities of China Clay at such giving-away prices as have followed immediately upon the dissolution of the Association, when many producers were seized with panic. Henceforth prices will gradually harden as demand increases, but the improvement will be a very gradual process in view of the greatly increased production over demand that has to be overtaken.

With the promised revival of trade in the Lancashire cotton mills, and the depletion of paper stocks following the abnormal consumption due to the general election, there are prospects of increased demands for bleaching clays. News from the paper mills shows that stocks of coated and surface papers, so largely used in the election for half-tone blocks, were practically exhausted, which means that the mills are now busy making good their lessened stocks. This factor should react favourably upon the demand for China Clay, of which large quantities are used in coated and calendered papers. The enormous extra quantities of coated papers consumed in the United States during the Presidential elections should also stimulate the demands for China Clay.

The deliveries for the nine months ended September, reveal a substantial increase over the corresponding nine months last year. The total for all classes was 660,009 tons against 607,010 tons, an increase of 53,000 tons, made up of 31,545 tons of China Clay, 12,208 tons ball clay, and 9,182 tons China stone. The actual tonnage in each class was:—China Clay, 1924—591,646 tons, 1923—560,097 tons; china stone, 1924—39,909, 1923—30,727; ball clay, 1924—28,454, 1923, 16,186.

China Clay and Glue

At a recent meeting of the T.A.P.P.I. of America paper testing and relative humidity occupied the attention of members, and it was suggested that the China Clay producers might with advantage co-operate to investigate possibilities of glue and the colloidal reaction of clay and glue.

Dr. V. H. Gottschalk, of the National Glue Association, described in a lengthy, but highly interesting, discourse a series of experiments conducted at the Bureau of Standards to determine the value of glue as a substitute for casein in the manufacture of coated papers. From Dr. Gottschalk's remarks and the contributions to the discussion by members, it was evident that interesting developments are likely to be announced at no distant date concerning the availability of glue as a substitute for casein. There are thirty or forty grades of glue and half of these are capable of use in the manufacture of clay coating mixtures. The important thing is to select the right kind of glue.

One of the chief troubles with glue, according to Dr. Gottschalk, was that it could not be made waterproof in an acceptable way, either with chrome alum or formaldehyde.

It was also necessary with glue to keep the coating mixture at a certain temperature, while casein mixtures could be used cold.

R. H. Norris, of the Dennison Manufacturing Company, inquired of Dr. Gottschalk if in his investigations he had been able to determine any colloidal action between the glue and the clay, and was told that colloidal condition was undoubtedly produced, the mixture being more of a dispersion than a suspension, with, as Mr. Norris suggested, a finely divided state of the clay and formation of a colloidal film enveloping the particles.

China Clay World Trade

The following statistics of tonnage relating to the world production of China Clay, both at home and abroad, and the exports and imports of the clay produced in their relations to the different countries, which we have compiled and arranged in tabular form, should provide useful information to the trade:—

World's Production.

Producing Country.	1919.	1920.	1921.	1922.
British Empire—				
United Kingdom	463,711	777,511	435,844	666,834
Canada	678	610	111	1,069
Australia	5,300	5,600	4,600	5,500
Total British Empire	469,700	783,700	440,600	673,403
Foreign Countries—				
Austria	—	—	7,700	—
Belgium	—	1,013	689	2,863
Denmark	11,692	17,522	4,018	4,823
France	55,600	64,674	—	—
Germany—				
Bavaria	126,360	191,359	222,987	—
Saxony	—	48,017	51,197	—
Italy	18,765	19,011	8,949	7,563
Rumania	—	—	4,500	5,180
Russia	—	16	—	—
Spain	33	935	1,421	1,434
Sweden	4,963	4,667	—	—
Algeria	—	354	—	—
United States	136,453	239,467	145,291	245,500
Chili	640	640	650	—
Korea	978	1,635	—	—
Total Foreign Countries	310,000	390,000	390,000	267,303
Total the World	780,000	1,170,000	830,000	940,766

The United Kingdom figures do not include China Stone. Columns left blank indicate that the information as to production is not available. In the case of the figures shown against Denmark these refer to exports only. The figures for France include kaolinic sand and felspar. The Saxony figures relate to crude as well as washed kaolin.

Exports of China Clay.

Exporting Country.	1919.	1920.	1921.	1922.
British Empire—				
United Kingdom	286,578	495,802	246,682	503,488
Foreign Countries—				
Austria	—	362	751	—
Czecho-Slovakia	—	—	171,182	214,961
Denmark	11,692	17,522	4,018	4,823
France	3,333	2,451	1,974	1,760
Germany	—	30,711	16,261	34,102
Italy	13	61	7	11
Sweden	772	1,342	166	320
Switzerland	4,364	5,937	3,655	3,975

Blanks indicate that figures are not available. The 1921 figures for Germany are for eight months, May to December. United Kingdom figures include China Stone.

Imports of China Clay
(Less Re-exports).

Importing Country.	1919.	1920.	1921.	1922.
British Empire—				
United Kingdom	—	964	1,349	474
Canada	7,607	12,081	7,438	11,972
India	8,665	22,286	14,895	15,144
Foreign Countries—				
Austria	—	13,811	17,711	—
Czecho-Slovakia	662	657	9	88
Denmark	3,843	3,980	2,992	5,169
Finland	—	9,726	6,470	9
France	37,773	41,791	25,859	60,179
Germany	—	128,995	90,060	186,404
Italy	9,880	20,764	16,283	17,890
Rumania	—	61	—	8
Sweden	15,988	23,001	11,306	19,419
Switzerland	19,831	45,559	22,037	31,900
United States	165,388	323,427	146,438	276,968
Argentina	676	747	1,129	532

Blanks indicate that information is not available. German 1921 figures are for eight months, May to December. United Kingdom figures include China Stone.

A Notable Paper Making Demonstration

The Paper Makers' Association's Enterprising Propaganda at Wembley

THE Paper Makers' Association, realising the necessity of creating interest in their section, approached the Paper Machinery Builders of Great Britain asking them to combine in making their exhibit at Wembley one of engineering as well as of commercial interest. The result was the miniature paper making plant installed to illustrate how paper is made from the raw material. The working paper machine with its auxiliary plant, with the co-operation and active assistance of the chief paper makers' engineers in the country, showed the manufacture of paper on the largest scale on which it has ever been publicly exhibited in the United Kingdom, making finished paper 30 in. in width. During the period of the exhibition the machine was operated by members of the Paper Makers' Association, who illustrated the manufacture of the various grades and types of paper made in Great Britain.

Description of the Process

The raw material is conveyed to the site as "half-stuff" after having passed through a preliminary process, where all undesirable ingredients are removed. The "half-stuff" is thrown into beaters of 200 lb. finished paper capacity. These are machines with large annular troughs, arranged with revolving rolls or propellers to circulate the stuff. These rolls are fitted with dull knives, which, coming into contact with fixed knives, cut up and disintegrate the stuff into fibres. The beating process takes from three hours, according to the quality of the paper which is being made. The stuff is next passed through a refining engine, the function of this machine being to complete the action of the beater. This machine consists of a cone-plug fitted with knives, revolving at a high speed inside a conical shell also fitted with knives.

The refined stuff is next dropped into large chests or storage tanks, which are fitted with agitators to keep the stuff in constant motion. These chests form a reservoir for feeding the machine. From the chests the stuff is pumped to the service cistern, and afterwards along a series of troughs where any suspended foreign matter is precipitated and collected. Water is added to dilute to the desired consistency before passing on to the machine proper, and the stuff is passed through strainers, where all coarse or unsuitable material is trapped.

The paper machine is designed to manufacture a finished sheet of paper 30 in. wide at 20 to 100 ft. per minute. The first part of the paper machine is known as the flow box. This box, constructed of wood, forms a reserve tank, providing a calm and even flow of stock to the wire. The stock at this point resembles mike in appearance and consists of 1 per cent. solid matter and 99 per cent. water. This stock is now prepared for converting into paper.

Forming the Paper

The main object of the "wire part" is to interlace the fibres and so form an even sheet, also to take away as much water as possible. The "wire part," as the term implies, consists of an endless wire apron of fine mesh. This wire is 28 ft. long and is carried by a series of rolls. The first roll after the flow box is known as the breast roll, the smaller intervening rolls as table rolls, and the first pair of pressure rolls arranged one above the other as couch rolls or couch press rolls. This pair of rolls forms the driving unit for the wire. The stock leaves the flow box and flows on to the wire at the breast roll end. A slice or sluice is arranged at this point to form a dam and to admit just sufficient stock to the wire for the required weight of paper. Once clear of the slice the stock flows along with the wire, the water falling through the fine gauze and leaving the interlaced fibres deposited thereon. This draining away of the water is practicable only up to a certain point, after which mechanical means must be employed to extract the remaining water, the first of which are known as suction vacuum boxes.

The Drying Process

These boxes, four in number, are placed immediately under the wire and apply a suction to the film of paper. They are connected to a vacuum pump, which draws away through the wire a certain amount of the moisture in the sheet. Arranged between the four vacuum boxes is a dandy roll revolving on the surface of the wet paper, which impresses the water mark. After leaving the vacuum boxes the wire travels through the couch rolls, and here the paper film is subjected to pressure of contact of the two rolls. As the moisture must be further reduced, the paper, carried on endless woollen felts, is passed through a series of press rolls, the top rolls of granite and the bottom of cast iron covered with rubber, known as the first and second presses. In actual practice these presses are more usual.

The paper is too delicate at this point to be conveyed by hand from the couch through the various presses and therefore soft woollen felts are arranged, which carry the paper through this section of the machine and prevent it from being burst by the high pressure between the rolls. As no further gain can be obtained by exerting pressure to extract moisture from the sheet of paper, cast iron drying cylinders are installed over which the paper passes. These dryers, turned and buffed to a perfectly smooth surface, are heated with steam and are geared to rotate in perfect harmony. The paper is kept in close contact with the dryers and conveyed through the dry part by means of cotton felts.

The paper on leaving the dryers is sufficiently dried for commercial purposes. The surface, however, is matt in appearance and unsuitable for printing purposes. To obtain a certain gloss or finish to the sheet a stack of heavy calender rolls is installed through which the paper is passed. The bottom roll only is driven, the remaining rolls being rotated by frictional contact. This frictional contact closes the sheet and gives the requisite finished surface, towards which the presence of China Clay in the stuff contributes.

The paper, on leaving the calender, is wound in reel form on tubes. A large water-cooled drum rotates, and against this the roll rests and winds up the paper to the required diameter. These reels, known as machine finished, are now ready for the winder. The paper here is the finished article, but is unsuitable for the market, on account of the width and faulty portions of the sheet. For the purpose of producing a perfect reel the paper is rewound and slit into various widths on a rewinding and slitting machine. This machine, being independently driven to the paper machine, can be stopped when a faulty portion of the sheet is seen, and, the inferior portion removed, the sheet is then pieced up and the winder restarted. The reel is now ready for the market, cut in the required widths, or it may be cut into rectangular sheets to be sold in the familiar reams and quires. This machine gave the visitor an opportunity of seeing the actual operation of paper manufacture, and with a little imagination he was able to picture the impressiveness of paper making on the full commercial scale.

Firms that Operated the Machine

The paper making machine was run by the following firms: Newsprint—Empire Paper Mills (1922), Ltd.; Edward Lloyd, Ltd.; Peter Dixon and Son, Ltd.; Chadwick and Taylor, Ltd.; Darwen Paper Mill Co., Ltd.; Star Paper Mill Co. (1920), Ltd.; Sun Paper Mill Co., Ltd. Wrappings—Cooke and Nuttall, Ltd.; Grove Mill Paper Co., Ltd. Wood Printing Paper—*Daily Telegraph* Paper Mill; Albert E. Reed and Co., Ltd.; Imperial Paper Mills, Ltd. Esparto Papers—Horton Kirby Paper Mills, Ltd.; East Lancashire Paper Mill Co., Ltd.; J. Tod and Son, Ltd. Fine Papers—John Dickinson and Co., Ltd.; Wiggins, Teape and Co. (1919), Ltd.

China Clay in a New Pottery Line

GOOD housekeepers will welcome the news that Booths, of Church Bank Pottery, Tunstall, Stoke-on-Trent, have succeeded in making British fire-proof cooking ware. The base itself is China Clay, ball clay, calcined flint, and stone, or quartz, or felspar. The great difficulty was to make a fine-textured ware which would withstand high temperatures. This has been successfully accomplished, and so assured are Booths of the excellence of their new ware that they guarantee it against breakage in use for six months from purchase date. It is known as the "Blue Line" because each article bears a blue line, no matter whether the colour be piecrust or white; the handles are in all instances black.

The Market in British Malaya

THERE is a universal demand for crockery articles by the inhabitants of Malaya. More than a million Chinese live in the country, and teapots, tea cups and rice bowls are a necessity to every Chinaman. Malays, too, numbering well over a million, create a demand for similar household requisites. Brass and woodenware do not in Malaya, as in some Eastern countries, take the place of earthenware and china utensils.

From the subjoined table it is apparent that this demand is being satisfied to an increasing extent by imports from China and Japan. To compete with these countries it would be necessary for United Kingdom pottery manufacturers to place on the Malayan market articles of crockery of the size and shapes to which the native is accustomed at a very low price. At present cheap Chinese and Japanese crockery can be bought in a very large number of native shops in every town, while English crockery is only sold by the big European stores. It would therefore also be necessary to create a demand for English crockery by the small native retailer, in whose hand the bulk of this business is at present centred.

The demand for earthenware latex cups for rubber plantations is now being met by cups of local manufacture, large beds of excellent China Clay having been discovered and supplies of fuel being also plentiful and convenient.

VALUE OF IMPORTS OF CROCKERY AND PORCELAIN IN 1922, 1923.

	1922	1923
United Kingdom	£24,994	£21,903
Hongkong	10,942	11,159
Other British Possessions	333	31
Total British Empire	£36,269	£33,093
Germany	1,320	3,458
Netherlands	5,838	8,034
China	44,067	79,553
Japan	50,813	97,876
Netherlands East Indies	2,348	1,752
Other Countries	1,102	2,058
Total Foreign Countries	£105,488	£192,731
Grand total	£141,757	£225,824

Home Production of Paper

Over 25,000 Tons Weekly

A LARGE modern news-print machine can turn out three tons of paper per hour, and makes paper 18 ft. 6 in. in width at the rate of a mile in eight minutes, which renders it possible for a bale of wood pulp, reaching the English coast in the morning, to be converted into paper on which the afternoon's editions of the evening Press are printed on the same day.

It may be interesting to know that in the making of a ton of paper the quantity of water used varies from 35,000 to 80,000 gallons, and that for every ton of dry paper produced on the paper machine approximately two tons of water have been evaporated from the moist sheet by the drying cylinders. Over 25,000 tons of paper are produced in Great Britain every week, the largest tonnage being in newsprint. The approximately normal weekly output is as follows :—

Newsprint paper	10,500 tons
Wood printing and writing paper	4,500 ,,
Rag and esparto printing and writing paper	4,500 ,,
Wrapping paper	4,500 ,,
Boards	1,500 ,,
	25,500 ,,

British paper makers supply two-thirds of the home consumption and, in addition, export their product to every quarter of the globe, having a world-wide reputation for the quality of their products. For work of the highest class British producers stand pre-eminent, whether in the costliest grades of hand-made and machine-made writing papers, printing and book papers, newsprint paper, or the various types of wrapping papers. During the war British mills devoted themselves to the production of special papers for munition purposes, but rapidly returned to their normal products on the cessation of hostilities, and a period of reconditioning followed, during which their plant has been brought to a high state of efficiency.

Production of Felspar

THE following figures relating to the production of felspar should prove useful to home producers of felspar in Cornwall and Devon. The figures refer to tonnage :—

Producing Country	1919	1920	1921	1922
BRITISH EMPIRE—				
United Kingdom—				
Felspar	4,695	3,365	1,090	830
China stone	43,043	73,102	34,886	38,921
Canada	13,106	33,815	26,668	24,756
Australia	—	4	26	85
FOREIGN COUNTRIES—				
Finland	—	7	1,464	1,740
Germany (Bavaria)	6,422	5,756	7,132	—
Italy	1,080	2,560	2,360	2,745
Norway	5,083	6,294	9,196	11,643
Russia	—	419	662	—
Sweden	12,698	11,855	19,845	22,011
United States	63,441	135,551	91,865	117,127

Blanks indicate that the information is not available. Canada's figures refer to sales only, and Norway's to exports only.

FELSPAR EXPORTS—TONS.

Exporting Country	1919	1920	1921	1922
BRITISH EMPIRE—				
Canada	21,749	36,886	20,164	22,035
FOREIGN COUNTRIES—				
Czecho-Slovakia	—	4,560	6,765	6,416
Finland	4,025	93	1,467	1,740
Netherlands	15	18	123	118
Norway	5,083	6,294	9,196	11,643
Sweden	9,412	17,249	19,936	21,691

Finland figures for 1919 include granite, Netherland figures include calcite.

IMPORTS OF FELSPAR.

Importing Country.	1919	1920	1921
BRITISH EMPIRE—			
Canada	1,200	1,668	1,038
FOREIGN COUNTRIES—			
Denmark	721	523	372
Finland	—	86	3
Netherlands	855	1,477	885
Rumania	—	10	—
Sweden	67	189	35

Potters' Clay

The Work of the Pug-mill

MR. ARTHUR HOLLINS, financial secretary of the National Pottery Workers' Society, read a paper at a meeting of the National Council of the Pottery Industry on " Improperly pugged clay and its effect on (*a*) the wage-earning capacity of the operatives ; and (*b*) the loss by defective ware to the employers." In the nature of the case, the paper was largely of a technical character, but it was of considerable practical value to all interested in the pottery trade—manufacturers, workpeople, and the suppliers of the raw material.

Vertical or Horizontal Pug

Having remarked that there was some difference of opinion among the operatives as to whether the vertical pug-mill was preferable to the horizontal, Mr. Hollins said vertical pug-mills are built on the same principle as horizontal and the only advantage of the vertical is the saving of motive power on account of the weight of clay assisting its own passage through the pug-mill. There are, however, the following disadvantages : (*a*) a vertical pug-mill is not so easy to feed, as the inlet where the clay body is introduced is necessarily very high above the floor level ; (*b*) the resultant clay body is not so consistent or homogeneous as in the horizontal ; (*c*) it is difficult to get a firm foundation such as can be obtained with the horizontal mill.

Mr. Hollins then proceeded to deal with the effect of improperly pugged clay on the wage-earning capacity of the worker. All workers in clay processes, he said, are employed at piece-work rates, which are calculated to produce a certain wage under the best conditions of work. It is obvious that if any factory should fail to function properly, the output of the worker is affected thereby and his wage-earning capacity reduced. The quality of the clay supplied, either in its consistency, plasticity or homogeneity, is not the most im-

portant factor. There is also a very important factor which should receive the attention of the clay managers, and that is the different quality of clay required by (1) hollow-ware jolliers and pressers; (2) dishmakers; (3) throwers; (4) plate and saucer makers. The quality referred to cannot be produced by the most perfect system of pugging but by the wise selection of the clay after leaving the presses. Better methods of selection of different qualities of clay-bodies to suit the requirements of the operatives in the several processes would not only improve the wage-earning capacity of the workers, but would result in a better quality of work.

Effect of Poor Material on Output

Having described various faults of pugging, Mr. Hollins said if a case has been made out that improperly pugged clay or clay not suited to the several processes, seriously affects output, an employer does not require to be told that if the maximum output is not being reached there is a certain amount of waste in motive power and machinery, and overhead costs are higher in proportion to the loss. So far as the loss by defective ware to the employers is concerned, it is a well-known fact that even in the clay state the employers had to pay the workers for cracked and blistered ware owing to the bad conditions of the clay supplied to the makers. Further, some of these faults do not appear until the ware has reached the biscuit warehouse in the form of cracked, crooked or blistered ware.

Among the suggestions put forward by Mr. Hollins were the employment at the pug-mill of a man who understands its principles and the quality of the clay he has to produce; improved facilities for storing and maturing clay; and the grading of pugged clay to suit the several branches of the trade. In conclusion, he said that the workers, to be able to produce the best result, must be provided with the best material. If this is done all misunderstanding between the clay worker and slip-maker would be avoided, and it is in the interest of the firm generally to have a contented set of workpeople.

China Clay Workers' Wages Settlement

To Hold Good for Six Months

As was stated in the last issue of THE CHINA CLAY TRADE REVIEW an application was recently made by the Workers' Union for an increase of 3d. per hour to 1s. 3d., in the wages of the China Clay day workers, who now receive £2 2s. for a 42-hour week. The increase, if granted, would have meant 10s. 6d. per week on the day wages, with a corresponding increase in piece rates, under which the clay workers so employed (drymen, sandmen, shippers, engine men, carpenters, and others) earn a much higher weekly income than the day workers.

The Joint Industrial Council of the China Clay industry representative of both the employers' and employees' sides, met to consider the application. The whole position having been reviewed, especially in the light of the recent collapse of the Association and the drastic lowering of prices, it was felt that the time was very inopportune for a revision of the wages scale in an upward direction. However, the council came to the decision not to alter the existing rates of wages in the next six months and embodied their findings in the following terms which they recommended for acceptance by the China Clay Employers' Federation:

1. That the present rate of wages shall exist for six months.
2. That all overtime over twelve hours in any one week be paid at time and a quarter; ordinary Sunday work, such as pumping, time and a half, and all special work on Sundays, double time.
3. Pieceworkers: Pieceworkers will receive the equivalent increase of one-fifth or 20 per cent. in addition to the piecework rates existing on August 23, 1920. (This means that there is no alteration to the present existing piecework rate). Pieceworkers not to work less than six hours, and this time to include brickmakers and pugmill men provided they complete their tasks.
4. Hours of work to be from 7 a.m. to 3.30 p.m. with one hour for meals, for the first five days; Saturdays from 7 a.m. to 12 noon, with half an hour for meals. The winter and summer charge of time still to apply. Night shift workers to work five shifts with pay for six shifts. Enginemen to be paid the minimum rate for every hour the engine is working, but meal time hour not to apply for over time.
5. Boys: Every boy must get a proportionate increase of men's increase in proportion to his pay. New boys to start at 1s. 9d. per day. It is agreed that in any advances for boys, the Pit Committee has power to recommend same to the employers.
6. Where day workers are put to work with pieceworkers, it is agreed that the Pit Committee should meet and report any cases to the Council where piecework rates are suggested to be applicable.
7. That all Pit Committees be re-established and recognised.
8. Any complaint in the first instance to be dealt with by the Pit Committee, and in the case of non-settlement it must be brought before the Joint Standing Industrial Council to adjudicate upon and settle.

This agreement to be in existence for six months.

These terms were later submitted to a meeting of the China Clay Employers' Federation, Mr. J. W. Higman presiding, and with the exception of one or two minor modifications, were accepted.

An Important China Clay Invention

IMPROVEMENTS in methods for the centrifugation of China Clay and clay, to be transformed into slips or pastes, form the subject of an invention by M. Louis Senez. The old method, he observes, of diluting the clay and then decanting the water into tanks requires such a length of time that in some works these tanks are often insufficient to supply slip for winter work. The more modern process, with the press-filter is so expensive, through the use of quickly worn cloths, and the yield, in proportion, is so small, that many manufacturers have had to abandon the system. Centrifugation of the clay and water, a method of more recent date, is rapid and less expensive. The object of this new machine is quickly to decant water containing China Clay or clays in suspension so as to produce slips or pastes as they are gradually required. This centrifugator may be conical, truncated-cone shape, or cylindrical. The diluted clay flows in and out and the products obtained can be removed.,

The fluid clay enters the machine and also passes out through pipes in the centre, whereas the slips or pastes obtained, after passing through one or several compartments acting as centrifugal regulators and communicating with each other at the base, are taken from the machine by aid of an extractor.

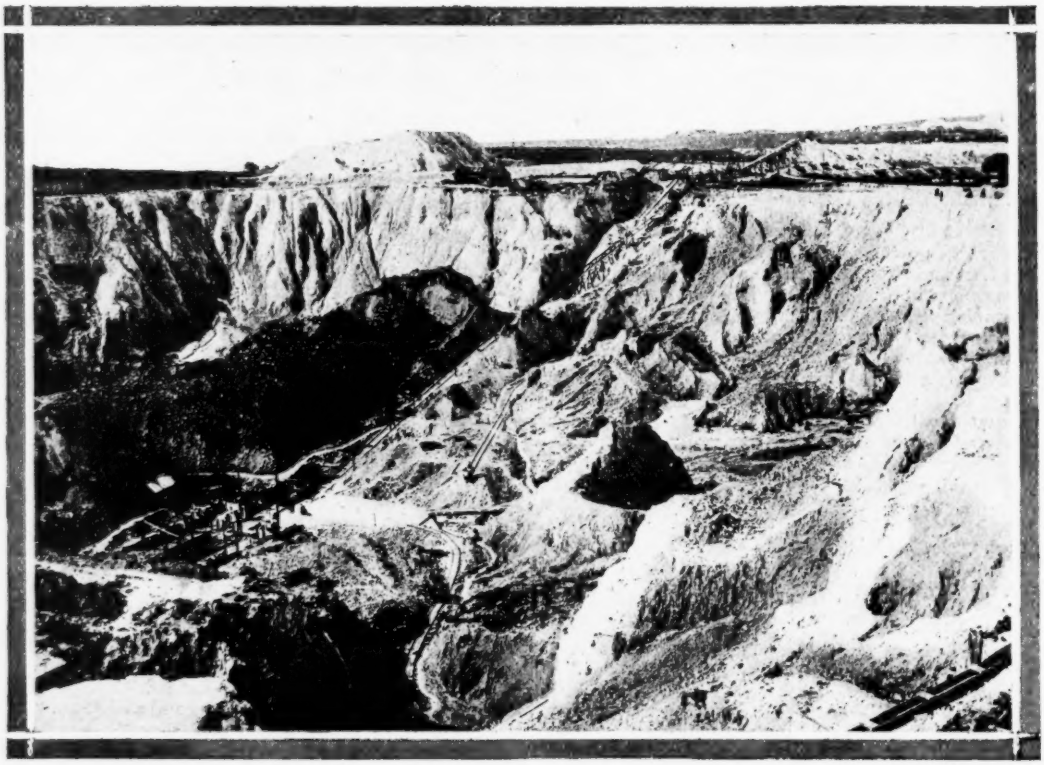
How the Machine Works

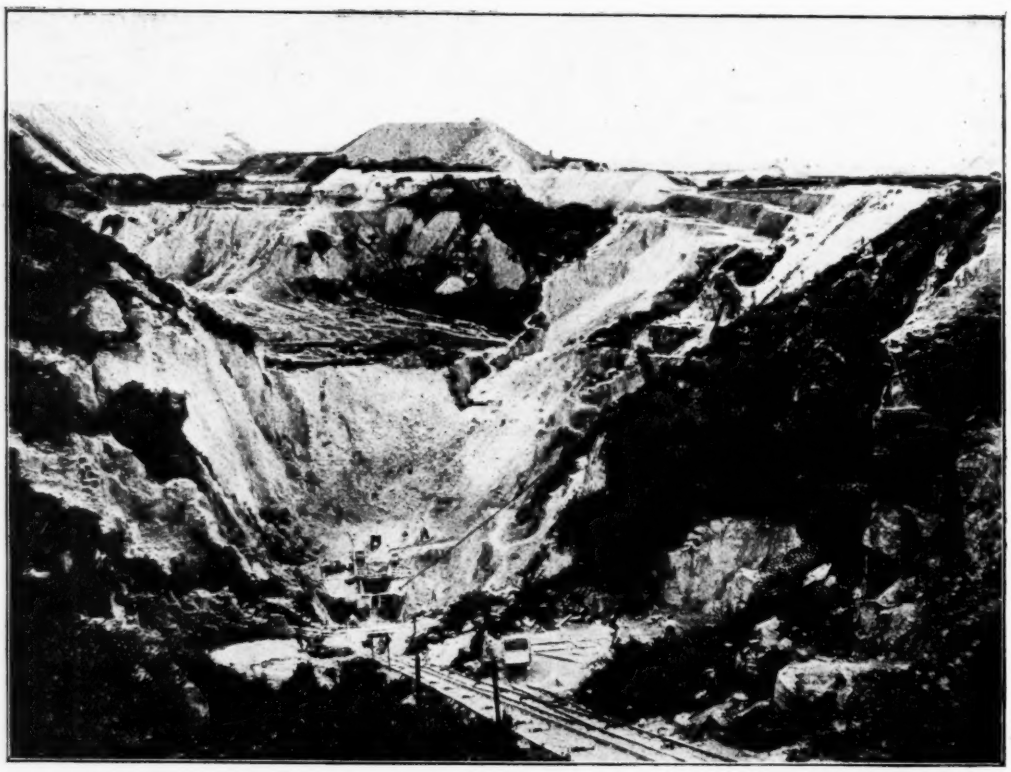
The machine may be single, i.e., with one compartment, or have several compartments forming superposed syphons. Working is so simple that labour is less and the production much greater and cheaper than in the old methods with settling tanks, press-filters, or even ordinary centrifugal apparatus. As soon as the machine is working the particles of clay floating in the water are, by the effect of rotation, thrown against the sides of the machine with greater or less velocity, according to the rate of speed. As the work of centrifugation proceeds, owing to the difference in density of the clay and water, the interior pressure due to centrifugal power and the quantity of product in the apparatus and pushes the slip or paste against the sides, on which it glides and falls into a compartment where it accumulates until the balance of the forces exerted between the two compartments arrests its progress. An extractor is then inserted more or less deeply in the clay, which drives it out of the machine. As the extractor has a great incline the slip or paste easily drops by its own weight on to the ground or belt conveyors. If, owing to defective centrifugation, there is a leakage of slip the latter finds its way into a compartment to be again subjected to centrifugation, or when this leakage is very great the slip is recovered by passing through a drain pipe and opening in the centre. As the slip is gradually produced and the water poured off the water level rises in the centrifugator and quickly reaches the height of the discharge pipe, into which it flows under pressure from rotation to then pass out.

By regulating the intake of the clay to be treated, as also the position of the drain pipe and extractor, the work is made automatic. The production per hour will be proportional to dimensions and velocity of centrifugation. (*French Patent, No. 578,371, September 24, 1924, M. Louis Senez.*)

Clay Schooner's Rough Passage

THE Danish schooner *Leif*, which arrived at Charlestown from Reval with a cargo of staves, lost about four hundred standards of deck cargo during the voyage out owing to bad weather. She took an outward cargo of China Clay.





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The Action of Heat on Kaolinite and on Kaolinitic Clays

By W. Vernadsky

A paper read at a meeting of the Refractory Section of the Ceramic Society.

In a recent paper by J. W. Mellor and A. Scott[1] on the action of heat on kaolinite and other clays, the authors put forward their explanation of the known facts relating to this very complicated phenomenon.

However, in the present state of our knowledge these facts appear to me to suggest a different interpretation; and it is the object of this short paper to outline this alternative explanation. Only by testing the validity of these new representations by new experiments and observations can we elaborate a theory of this very important phenomenon. This theory presents not only a scientific but also a practical interest.

It seems to me that the behaviour of kaolinite in the thermic field of our experiments (0–2000° C.) indicates that *all observed transformations correspond to one and the same process.*

These changes are in close agreement with the chemical structure and the chemical functions of kaolinite and kaolinitic clays.[2] The process of decomposition of kaolinite consists in gradual loss of water and silica and in a corresponding chemical transformation of the alumosilicic residue. *We observe a gradual transformation of the complex alumosilicic acid—$Al_2Si_2O_6(HO)_2{\cdot}H_2O$ (kaolinite)—into definite alumosilicic anhydride, the formula of which is $Al_6Si_2O_{13}$ or $Al_8Si_4O_{20}$ (mullite or keramite).*

I. Dehydration of Kaolinite

The process begins by dehydration of kaolinite, i.e., by the formation of a complex alumosilicic anhydride from an alumosilicic hydrate.

From a chemical point of view kaolinite and kaolinitic clays may be considered as *alumosilicic acids* of peculiar chemical constitution. The different chemical character of molecules of water in kaolinite is proved beyond doubt.[3] In kaolinite—$2K_2OAl_2O_3 2SiO_2$—*only one molecule of water can be replaced by bases.* Thousands of cases of this reaction are observed in the earth's crust and in the laboratory. Furthermore, no difficulty is experienced in obtaining many different anhydrous or hydrated salts of kaolinitic acid, such as $Na_2Al_2Si_2O_8$, $K_2Al_2Si_2O_8$, $CaAl_2Si_2O_8$, $Na_2Al_2Si_2O_8 4H_2O$, etc., from kaolinite and kaolinitic clays, or in producing the contrary reaction, viz., converting these salts into kaolinite or kaolinitic clays. If the character of but one molecule of water is clear, the chemical nature of the other can be expressed hypothetically as one of *zeolitic water.*

The formula of kaolinite, $2H_2OAl_2O_3 2SiO_2$, may be then written:

$$Al_2Si_2O_6(HO)_2{\cdot}H_2O.$$

Our actual knowledge of the properties of zeolitic water is, generally speaking, very incomplete. It is a form of dissolved water, *a case of solid solution,* but a very peculiar one. It is a solution in the crystalline space lattices. The forces which come into play in the phenomenon of the zeolitic solutions are of a crystalline, vectorial nature. The simple molecular relations between the zeolitically dissolved substance (water in this case) and the crystalline space lattices ($Al_2Si_2O_6(HO)_2{\cdot}H^2O$ in this case) are manifestations of regularity of structure of the crystalline field of crystalline lattices. They correspond only to a complete equilibrium and can exist as such only in a definite thermodynamic field. At other temperatures the zeolitic solution is in a state of dissociation; zeolitic parts can enter and disappear without altering, or very little, the crystalline structure (crystalline lattices), which is determined by the properties of the solvent.

There are some vague analogies between colloidal and zeolitic water; but the differences are greater. Colloidal water is retained by superficial forces of crystalline particles (micels), the zeolitic water by interior forces of crystals (space lattices). In the first case the vectorial properties of the matter are invisible; in the other they determine the phenomenon.

In the phenomenon of heating the twofold character of the water of kaolinite is not very apparent under the ordinary conditions of our experiments. There must be some explanation of this fact, but it cannot yet be stated with absolute certainty.

But, in explaining the phenomenon of heating the twofold character of the water of kaolinite, which is proved by chemical observations and experiments, must not be overlooked.

It is evident that the twofold character of the water must, in one way or another, be expressed in the phenomenon of heating. If it is not clearly manifested, it must be complicated by secondary phenomena, probably due to the properties of zeolitic water.

But it is clearly expressed in the *different thermal effects* which accompany the loss of the two types of water. A great part of the water is lost at a definite temperature (450–760° C.), and is accompanied by *absorption of heat,* as was established by Le Châtelier. The other portion of the water disappears on heating proportionately to the rise of temperature *without any expressed thermal effect.* It seems that the quantity of water, the loss of which is accompanied by latent heat, corresponds to one molecule (about 7 per cent. by weight—e.g., in the experiments of Prof. T. Samoilov, 1912, Prof. V. Agafonoff in 1924, etc.).

The manifestation of a thermal effect is characteristic of a chemical process and must correspond to the destruction of the compound $Al_2Si_2O_6(HO)_2$, which forms the space lattices of the kaolinite. Above the temperature point of latent heat the crystalline structure of the compound (solvent) is changed and kaolinite, as such, ceases to exist. As is shown by experiments, the kaolinite is transformed into an anhydrous leverrierite—$Al_2Si_2O_7$.[4]

But the dehydration begins before this temperature point is reached. This loss of water does not manifest itself in thermal curves. The beginning of this dehydration is not associated with one fixed temperature point, but varies for different specimens of kaolinite and under varying experimental conditions. Apparently, in crystalline kaolinite (i.e., when crystal individualities can be seen under the micrsocope), this water begins to disappear at temperatures above 100° C. At this moment kaolinite presents all the properties of a substance in a state of dissociation. We must conceive this water as dissociated from zeolitic solution. The zeolitic water begins to disappear *before* the chemically bound water, but this loss is not terminated at the point of decomposition of alumosilicic hydrate and is interrupted by the heat absorption associated with the chemical transformation of a crystalline compound (formation of leverrierite) and with a constant temperature (latent heat).

When this chemical transformation is complete the temperature begins to rise and zeolitic water again begins to disappear. The last traces of zeolitic water in crystalline lattices can be expelled only with great difficulty at high temperatures.

The process of dehydration can be represented by the following table:—

At Ordinary Temperatures.	Kaolinite.	$Al_2Si_2O_6(HO)_2{\cdot}H_2O.$
	↓	↓
>100-750° C.	oKaolinite in a state of dissociation.	$Al_2Si_2O_6(HO)_2(1\text{-}9)H_2O$ $+9H_2O.$
	↓	
750-760° C.	Hydrated leverrierite in a state of dissociation.	$Al_2Si_2O_7(1\text{-}9)H_2O$ $+9H_2O.$
	↓	
<600° C.	Anhydrous leverrierite.	$Al_2Si_2O_7.$

The temperature 750-760° C.—a definite range of temperature—must divide the *kaolinitic field* from the *leverrierite field.* Both these compounds can contain zeolitic water.

1. J. W. Mellor and A. Scott, The Action of Heat on Kaolinite and other Clays, 1924.
2. W. Vernadsky, On Kaolinitic Clays. *La géochimie.* 1924. (Alcan.)
3. The phenomena of hydrolysis of alumosilicates are very complex and hydroxyl groups showmany peculiarities, but this does not change the general character of the phenomena.
4. V. Agafonoff and W. Vernadsky. *Comptes rend.*, 178, 1924, 1082.

II. Nature of Decomposition of Kaolinite at 750—760° C.

The existence of anhydrous leverrierite above 760° C. is, it seems to me, established by experiments the results of which have recently been published.[5] Above this temperature the dehydrated kaolinite is homogeneous and crystalline; no amorphous or vitreous substance exists. The anhydrous leverrierite here obtained has definite (different from kaolinite) optical properties and a different specific gravity. The determination of the density of the dehydrated product is alone sufficient to prove the hypothesis of the decomposition of dehydrated kaolinite into free silica and free alumina.

It is firmly established that the complex $Al_2Si_2O_7$ is a very stable one in natural and artificial compounds. It does not change in thousands of chemical reactions and remains unchanged in many transformations of alumosilicates. In the earth's crust the kaolinites and kaolinitic clays are always produced by the transformation of peculiar alumoslicates (felspars and others), which contain this characteristic complex of elements. This complex of koalinite is never formed from free silica (or silicates) and free alumina (aluminates). The kaolinite and kaolinitic clays are generally transformed by metamorphism into the same alumosilicates, which contain the complex $Al_2Si_2O_7$.

This complex is formed from free silica (or silicates) and free alumina (or aluminates) only at high temperatures in the magmas or, at high pressures, in hydrothermal reactions above 180° C. We have not succeeded in obtaining it in the laboratory under other thermodynamical conditions. It seems that the formation of $Al_2Si_2O_7$ is an endothermic process.

The compound $Al_2Si_2O_7$, in a free state, has the properties of an anhydride; with water it forms acids, with metallic oxides salts.

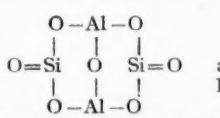
The binding medium between Al_2O_3 and SiO_2 can only be destroyed by the action of strong acids. At high temperatures the salts of $Al_2Si_2O_7$ are stable (up to 1800° C.); free $Al_2Si_2O_7$ does not exist above 1000° C.

The hypothetical decomposition of $Al_2Si_2O_7$ at a temperature of 450-500° C. has no analogy in known phenomena occurring in the earth's crust or in the laboratory.

The facts enunciated in the preceding paragraph may be generalised in an empirical representation on the hypothesis that the complex $Al_2Si_2O_7$ forms, in compounds in which it exists, a peculiarly stable nucleus, a complex of elements which has a real, independent existence.

Its stability under many different reactions can be expressed by a cyclical structure, analogous to other cyclical structures known in natural compounds (benzols, naphthenes).

The simplest representation of this *kaolinitic nucleus* would then be :—

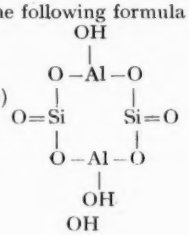


anhydrous leverrierite.

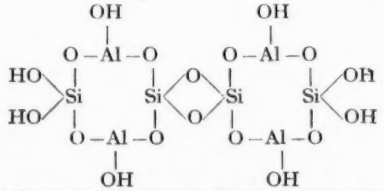
We must admit, in order to explain the known facts of the chemistry of alumosilicates, (1) that hydroxyl groups are bound with Al atoms and (2) that a few kaolinitic nuclei can be bound together.

We then obtain the following formula :—

Kaolinitic acid (not known)



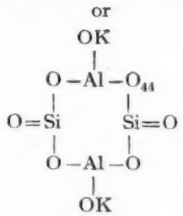
Kaolinite



5. V. Agafonoff and W. Vernadsky, *l.c.*, 1924.
7. By biochemical processes at low temperature, *cf.* W. Vernadsky. *La géochimie.* 1924.

or

Phacellite



III. Nature of Transformation at 900—1060° C.

Many years ago Le Châtelier showed, for the first time, that there is a very obvious *escape of heat* at about 900-1000° C. during the heating of kaolinite.

This heat liberation is often explained by a polymorphic transformation of free Al_2O_3. We have seen that the existence of free Al_2O_3 in dehydrated kaolinite is very doubtful and contradicts the homegeneity of this substance. The temperatures of liberation of heat, of polymorphic transformation of alumina and of the heating of kaolinite do not correspond. The polymorphic transformation of alumina takes place between 800-900° C., while the heat liberation of kaolinite occurs at 900-1000° C.[8]

The heat liberation receives a simple explanation in admitting the existence of anhydritic leverrierite in dehydrated kaolinite.

The leverrierite does not exist at high temperatures. It is never found in the corresponding conditions of the earth's crust and is decomposed on heating. This decomposition is *accompanied by heat liberation, because leverrierite—$Al_2Si_2O_7$—and kaolinitic nuclei generally, are endothermic compounds.* This temperature represents the limit of the leverrierite field. Above it the leverrierite cannot exist.

IV. Formation of Sillimanite

The nature of the product formed by its decomposition under these conditions has not been definitely determined. It seems, from recent experiments of N. Bowen and J. Grieg,[9] that the process of the decomposition of Al_2SiO_7 is accompanied, not by the formation of *sillimanite*—Al_2SiO_5—but of an alumosilicic anhydride, richer in alumina-mullite,[10] or *keramite*.[11] It is certain that, by this decomposition, free silica (cristobalite according to N. Bowen and J. Grieg) is liberated, but in *many cases* the reaction does not correspond to the equation :—

$Al_2Si_2O_7$	=	Al_2SiO_5	+	SiO_2
anhyd. leverrier.		sillimanite.		cristob.

It corresponds to the equation :—

$3Al_2Si_2O_7$	=	$Al_6Si_2O_{13}$	+	$4SiO_2$
anh. leverr.		mullite		crist. or
$4Al_2Si_2O_7$	=	$Al_8Si_3O_{18}$	+	$5SiO_2$
anh. leverr.				crist.

N. Bowen and J. Grieg could never obtain sillimanite by heating the kaolinitic clays under different conditions; they always obtained mullite, to which they gave the formula $Al_6Si_2O_{19}$. The published analyses are perhaps better expressed by the formula Al_8SiO_{18}, which I proposed many years ago.[12]

But sillimanite certainly exists in nature, where it is formed under conditions very analagous to those of the laboratory, viz., by the action of heat or great pressure upon kaolinitic clays.

In my former experiments[13] I obtained crystals which could be analysed and gave the formula of Al_2SiO_5 (sillimanite). In two determinations of SiO_2 I obtained 36·8–37·31 per cent., and for Al_2O_3 63·65 per cent. Other experiments gave me a product, which could not be microscopically distinguished from sillimanite, but the analyses gave 28·6–29·5 per cent. SiO_2.[14] It is mullite or keramite.

8. The determinations of G. Tammann and W. Pope give 850° and 1060° for pure free alumina and 930° for kaolinitic clay of Oschatz (*l.c.* 1923, 49).
9. N. Bowen and T. Grieg, *J. Amer. Cer. Soc.*, 7, 238, 1924.
10. N. Bowen, T. Greig and E. Zies, *Jour. Wash. Acad. Sc.*, 14, 183, 1924.
11. J. W. Mellor and A. Scott, *l.c.*, 1924.
12. W. Vernadsky. *Bull. Soc. Natur. Moscou*, 1891, p. 545.
13. W. Vernadsky, *l.c.*, 1891, pp. 74–76.
14. On heating topaz, the homogeneous crystalline residue gave 29·8–30·4% SiO_2 (*l.c.*, 1891, pp. 78–79).

I could not determine the conditions at which sillimanite was formed. It seemed to me that it was formed near the temperature of heat liberation.[15] The addition of 1·7 per cent. MgO appeared to favour the formation of sillimanite.[16]

V. Formation of Mullite (Keramite)

As a rule it is not sillimanite, but a product richer in Al_2O_3—*mullite or keramite*—which is formed under these conditions.

The recent experiments by American chemists confirm my early results and deductions.

In 1891 the action of heat on kaolinite was represented by me by the following scheme [18] :—

$Al_8Si_8O_{28}$.
↓
$Al_8Si_4O_{20}$ — sillimanite.
↓
$Al_8Si_3O_{18}$
↓
Al_8O_{12} — corundum.

This scheme is very similar to that of N. Bowen and J. Grieg. The differences are to be found in admitting the existence of the sillimanite field and in the formula for mullite, which I gave as $4Al_2O_3 3SiO_2$ and not $3Al_2O_3 2SiO_2$.

It has hitherto been very difficult to decide which of the formulæ—$Al_8Si_3O_{19}$ or $Al_6Si_2O_{13}$—best expresses the composition of mullite. In 1891 I indicated that it was impossible for me to distinguish the different varieties of rhombic alumosilicic anhydrides by optical methods.[19] Now, despite the great progress in our optical methods and the splendid equipment of the Carnegie Laboratory, the American savants have come practically to the same conclusion.[20] The rhombic varieties cannot be distinguished one from the other by ordinary optical methods.

TABLE OF ANALYSES OF MULLITE.

	$Al_6Si_2O_{13}$.	$Al_8Si_3O_{18}$.	Deville.	Vernadsky.
SiO_2 ..	28·2	30·6	4 29·1–29·5	29·7
Al_2O_3 ..	71·8	69·4	70·2–70·9	70·3
	Vernadsky.	Vernadsky (Kaolinite).	Littleton.	Bowen.
SiO_2 ..	29·8–30·7	29·9–30·1	27·35–27·60	29·36
Al_2O_3 ..	—	—	72·87–73·16	69·05
	Zies.	Cox.	Cox.	
SiO_2 ..	29·04	30·07	28·89	
Al_2O_3 ..	69·63	69·93	71·11	

The existence of a few different alumosilicic anhydrides is very probable. Some groups of alumosilicates, such as dumortierite or grandidierite, cannot be explained otherwise.

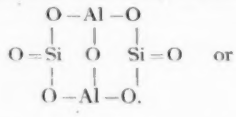
In the present state of our knowledge we can represent the whole process of heating kaolinite by the following scheme :—

1. *Kaolinitic Field.* 0 – 450° C.
$Al_2Si_2O_6(HO)_2.H_2O$
↓
$Al_2Si_2O_6(HO)_2.(1–9)H_2O + 9H_2O$
↓
2. *Leverrierite Field.* 450–1060° C.
$Al_2Si_2O_7.(1–9)H_2O + 9H_2O$
↓
$Al_2Si_2O_7$
↓
3. *Sillimanite Field.* ? 1000° C. – ?
$Al_2SiO_5 + SiO_2$
↓
4. *Mullite Field.* 1200 – 1800° C.
$Al_8Si_3O_{18} + SiO_2$
↓
$Al_6Si_2O_{13} + SiO_2$
↓
5. *Corundum Field.* 1800 – 1920° C.
Al_2O_3 + liquid.

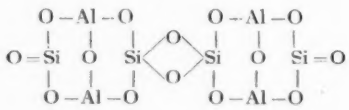
15. i.e. 1000° C. ; sillimanite seemed to be the first product of the decomposition of $Al_2Si_2O_7$ (*l.c.*, 1897, p. 74).
16. W. Vernadsky, *l.c.*, 1891, p. 76.
18. W. Vernadsky, *l.c.*, 1891, p. 77.
19. W. Vernadsky, *l.c.*, 1891, pp. 72, *et seq.*
20. Alumosilicic anhydride, $Al_4Si_3O_{12}$, obtained by Fremy and Feil, must be monoclinic or triclinic (Tannottar-Fremy et Feil, *Comptes rend.*, 85, 1877, p. 1033). On repeating their experiments I obtained rhombic crystals (*l.c.*, 1891, p. 70).

It is interesting to note that very simple structural representations of these compounds—in agreement with many of their chemical properties—can easily be constructed, e.g. :—

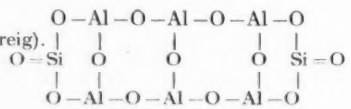
Leverrierite.



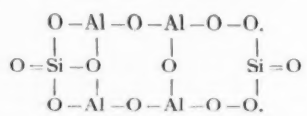
or



Mullite (N. Bowen and J. Greig).



Sillimanite.



The formula of N. Bowen and J. Grieg for mullite, viz., $Al_6Si_2O_{13}$, is more simple and corresponds more nearly to the theory of kaolinitic nuclei than $Al_8Si_3O_{18}$.

"Pine Pump-rods" Where and Why They Fracture

By China Clay "Captain"

DURING the post-war period it has come to my knowledge that at *three* different clay-pits the wood main rods of the Cornish Plunger Lifts have been unable to stand the alternate push and pull to which they were constantly subjected, consequently, although in each case the wood was from 12 to 14 in. square, they pulled apart with disastrous consequences to the adjoining machinery.

In all these case the fracture occurred at or near the " brace of shaft," where the rod had been exposed to varying climatic conditions.

Of course, nearly the greatest strain comes there as well ; it is probably slightly greater at or near the top, but the wood is reinforced with iron caps or plates for the first 12 or 18 ft., and it is just below these plates in the beam engine and below the connection in the bell-crank bob lifts that the timber gives out. Pine timber is generally used for main rods. In a table which I have by me the ultimate strength of pine wood per sq. in. of cross-section is tabulated as 11,000 lb. tension and 6,000 lb. compression. According to this table, a rod 1 ft. square should only break under a tensile strain of 700 tons and approximately half that amount in compression.

As at neither of the " breakages " mentioned nothing near such a strain was put upon them, there must either be a great difference in pine, or the baulks in question must have greatly deteriorated. Before we go into that, let us look at the possible strain that might be applied under working conditions. At one pit, when the rod broke, the big 11-ton bob of the beam engine jumped clean out of the stools or plummer blocks. This engine, Watt type, has a cylinder dia. 40 in. (area 1,256 sq. in.), boiler pressure 100 lb. per sq. in.

So when the " steam horn " springs up, in round numbers a force of 56 tons is suddenly let loose on the piston to send it —in spite of the " cut-off "—to the end of its long 9 ft. stroke.

That is, counting the boiler pressure as absolute pressure, which perhaps we hardly ought to do, for no air-pump bucket has a vacuum of quite 30 in., but even the then fraction of $\frac{56}{700}$ is only $\frac{8}{100}$ of what it should bear, or, taking it as a " live load " and doubling it, it doesn't come up to a quarter of what it is supposed to stand.

Evidently, with such a large factor of safety in the beginning, something must happen to whittle down the resistance to the breaking point. Probably the timber suffers from fatigue similar to iron, going over 60,000 double strokes per

week, year in and year out, and changing from push to pull every time. No doubt the fibres suffer from the varying strain.

But I think Anno Domini and the weather should be held largely accountable, for " age and decay " were very much in evidence in all the cases quoted. The wood had been working exposed to the elements for at least 15 years.

It appears that frequent change from wet to dry has a very bad effect on timber, for if kept always wet or always dry it will last for an indefinite period. This being so, might not means of preserving it be employed with profit, such as pickled timber for the top of mainrod, or, if that is too expensive, painting or tarring it at intervals?

Or, as a measure of safety, have additional strapping-plates to span the weak part. Then after 10 years have it thoroughly examined annually.

If some of these measures were employed it would save many a serious " breakage," for it's not only having to buy a new baulk of pine—having the pumps idle while replacing—with production at a standstill, but, as I remarked at the beginning, it generally damages something else in the shaft or engine house—in fact, if Cornish pumping engine houses were not substantially built, it would go far to batter down the building besides endangering the lives of the engineman or shaftman, so a word of warning may not be out of place. Take the tip, have a look at your main rod and test it with a hatpin-like probe.

China Clay Port Official's Death

CHARLESTOWN estate has sustained a great loss by the death, in his seventy-first year, of Mr. Henry James Bulteel, estate agent, Charlestown, St. Austell. He had, with the assistance of his son, Mr. Walter Bulteel, continued to conduct the affairs of the estate up to his demise.

Born at Plymouth in 1853, he was a member of a very old Devonshire family and was the grandson of the late Rev. Henry B. Bulteel, of Plymouth, who had a very distinguished career at Oxford. Mr. Bulteel was educated at Eton and the Royal Agricultural College, Cirencester, and in 1886 was appointed to succeed Mr. Henry Jenkins as steward to the Charlestown Estate Co., Ltd. He was also estate agent for Sir Charles Graves-Sawle's Penrice estate, and was also connected with other properties, having been since 1886 actively engaged in land and property management.

During his 38 years' stewardship of the Charlestown estate he had worked assiduously to foster trade at the seaport—endeavouring at all times to facilitate the importing of coal, grain, cement and timber, and the exporting of China Clay. Through his initiative many improvements to facilitate the shipment of China Clay at Charlestown had been undertaken.

The interment took place at Bridgetown, Totnes, and a memorial service was held in St. Paul's Church, Charlestown. Several representatives of China Clay firms were present. Mr. Alan P. Coode represented Sir Charles Graves-Sawle. The Charlestown Estate, Ltd., was largely represented.

Saskatchewan's Clays and Chemicals

IT is predicted by ceramic experts that eventually Saskatchewan will become the leading clay-producing area of Canada, and with development this province should, in the manufacture of pottery and clay products, attain first importance. Clays found there range all the way from the lower grades used in the manufacture of bricks and tiles to high-grade pottery clays. Some of them have been classified as ball clays such as are used in the manufacture of tableware, and compare favourably with the highest grades of this class of clay found in the Old World. Some of these deposits have been located adjacent to lignite fields, and it is considered by engineering experts that the working of the clays and lignites together will be found practicable and profitable when sufficient capital is interested in this enterprise. Saskatchewan has large deposits of sodium sulphate of great density, for which Canada's rapidly-developing pulp and paper industries, as well as chemical plants generally, offer a large and broadening market. Plants are being established for treating this chemical, and large shipments have already been made. Other chemical deposits have been located in various parts of the province offering great possibilities for future development.

Kaolin in Chile

OF late years kaolin has become an important material in Chile and, as the probability of commencing manufacture of pottery and similar articles grows greater, the interest evinced in this question becomes keener. Consequently, numbers of extensive deposits have been discovered.

According to statistics, says the *Boletin de la Sociedad de Fomento Fabril*, No. 2, 1924, the production of clay in Chile amounted to 5,738 metric tons in 1920, valued at 153,778 pesos, and that of kaolin 650 tons, valued at 26,132 pesos. As is evident, this industry is only in its infancy from the point of view of production; but it has considerably increased of late years, and some shipments have been made, especially to the United States. To give an idea of the importance acquired by the industry some details have been noted relating to deposits which could be profitably worked. The geological formation of Chilean kaolin is conformable with the general features met with in other parts of the world.

Kaolin Deposits in the Province of Curico

There are rich beds of pure white kaolin at Parronal which, according to the proprietors, are inexhaustible. A works will shortly be opened to produce a first and second class kaolin.

A very satisfactory porcelain has been made with this kaolin. The present proprietor of this deposit is Señor Pedro Goldsack.

Chango Muerto Deposit (Coquimbo)

In this locality there is an extensive kaolin deposit in the midst of granite. It is in form of a soft white mass, containing intervening yellowish sections, mixed with grains of quartz A sample analysed contained :—

	Per cent.
Silica	59·7
Alumina	29·6
Water	9·0
Lime	1·7

San Lorenzo Deposit (Aconcagua)

The kaolin lies in a felspathic rock in form of very white irregular masses. It constitutes a large portion of a hill belonging to the granite formation of the coast. This kaolin contains :—

	Per cent.
Silica	53·35
Alumina	30·20
Lime	0·2
Magnesia	0·09
Iron Oxide	0·5
Water	15·60

There are large quantities.

Iahuel Deposit (Aconcagua)

This kaolin originates in the formation of a mass of pegmatite and is mixed with grains of quartz. It is white, very plastic and very abundant.

Montenegro Deposit (Santiago)

Near the railway station of this name, Santiago-Valparaiso line, there is a very extensive and rich deposit belonging to Señor Daniel Bello, in the district of Rinconada.

Rio Claro Deposit, Rere (Concepcion)

These very rich beds of exceedingly pure kaolin are to be worked by a recently formed company, the " Sociedad Kaolin, Limitada," domiciled in Morandé 291, Santiago.

It is only during the last few years that attention has been given to kaolin, and the numerous deposits therefore have yet to be thoroughly surveyed and estimated. Nevertheless, it may be taken for granted that the future development of the keramic industry will lead to the working of these deposits with a sufficient production for exportation at moderate prices.—*Boletin de la Sociedad de Fomento Fabril*, No. 2, 1924.

China Clay Notes and News

Pottery Possibilities at Plymouth

A correspondent in the West of England press has been suggesting the establishment of a new industry in Plymouth in connection with China Clay. He points out that Plymouth was once famous for its pottery, and everything is in favour of Plymouth. The China Clay can be had on Cattewater, and it costs many shillings less per ton to bring coal to Plymouth than it does to take clay to the Potteries. There would be a lesser weight of coal to bring here, than of clay to the Potteries, as 100 tons of coal will bake 135 tons of pottery. The cost of crates for conveyance is an expensive item and the cost of sending returned empties is so great that it does not pay to return them, and they are practically wasted. The rail carriage on pottery to the West of England is heavy, and a great saving could be effected.

In addition to pottery, with the lower grades of clay roofing, ridge, floor and hearth tiles and drain pipes could be made from China Clay. There is cheap distribution from Plymouth by water to Looe, Fowey, Polperro, Mevagissey, Falmouth, Dartmouth and all the west-country ports.

New China Clay Organisation

China Clay Producers, Ltd., was registered on October 20 as a company limited by guarantee, and not having a share capital, with 100 members, each liable for £10 in the event of winding up. The objects are: To ensure and accelerate the better distribution of supplies of China Clay among the customers who purchase clay from the members of the company; to co-operate with any China Clay producers for their mutual benefit; to refine, crush and prepare for market, search for and get China Clay of all kinds; to carry on business as miners, metallurgists, quarry owners, ship and barge owners, wharfingers, warehousemen, carriers, etc. The management is vested in a Board, the first members of which are connected with the largest and some of the oldest-established China Clay firms in the industry. They are: T. M. Stocker, Trelawney, St. Austell; R. Martin, Lee Moor House, Roborough, Devon; W. Sessions, St. Austell; H. Nicholls, Gwarder, St. Austell; J. W. Higman, Polgray, St. Austell; H. D. McLaren, 38, South Street, W.1. (barrister),; H. S. Pochin, Worsley Street, Manchester; J. Hooper, Trevidder, St. Austell; J. Perry, Penvale, St. Austell; J. Lovering, Cosgarne, St. Austell; S. J. Dyer, King's Avenue, St. Austell; A. D. S. Stocker, Stoke-on-Trent; F. Parkyn, Glenview, St. Austell; F. R. Lovering, Caprera, St. Austell (all China Clay merchants except where otherwise stated). The Board shall consist only of members of the company or of directors of any company which are members, but save with the consent in writing of the board, no member shall be qualified to hold office as a director (1) is the owner of any business producing British China Clay in respect of which he has not entered into a producer's agreement, or (2) holds a controlling interest in any company, or is a member of any firm producing British China Clay which is not a member of the company or holds any office in any such company or firm. Secretary: H. Ball. Solicitors: Rawle, Johnstone and Co., 1, Bedford Row, W.C.1. The registered office is at St. Austell.

General Election Depletes Paper Stocks

There was such a rush for paper for election purposes that, by the time polling day arrived, stocks of certain grades of paper had been cleared entirely. Super-calendered printings, imitation arts, coated arts, and cream woves, in addition to white boards of all kinds were the goods most in demand. Preference was given to everything with a high finish. Even well-rolled pulp boards were preferred to the cheaper white triplex, as everything as far as possible had to bear the half-tone portrait of the candidate. The expression of a printer when ordering paper for election work recently is a very fair index of the extent to which stocks were being cleared out. He asked for a certain kind that he considered most suitable for the work in hand. When told that there was none left in stock, he said "anything else will do so long as it is the right size."

Only a knowledge that if he went elsewhere he would be no better off and only waste time into the bargain, would cause a consumer to be so accommodating as this.

Although paper stocks have been depleted to starvation point, the shortage will only be temporary, as the welcome orders that the mills have received to replenish stocks will soon be executed, and in the process some of the advantages resulting from abnormal paper consumption will be reflected in increased orders for China Clay.

The huge consumption in Presidential Election literature in the United States of America, with their strong preference for coated papers for illustration purposes, will have a stimulating effect upon the China Clay export market.

China Clay Exhibition

The annual meeting of the Royal Institution of Cornwall was held at St. Austell last month. Canon H. H. Mills, who presided in the absence of the president, Lord St. Levan, said the object of holding their meetings in places other than Truro was in order to make the activities of the Institution of wider interest. Mr. Henry Stocker gave an interesting exhibition of China Clay and other materials connected with its production, including samples of overburden, coarse gravel, coarse and fine sand, and samples of potting and bleaching clays, together with samples that had been "fired." There were also exhibits of China Stone in its raw state, ground stone and "fired" stone.

China Clay Merchant's Purchase

The small country estate of Duporth, between Porthpean and Charlestown, near St. Austell, was last month offered for sale by auction at the Lecture Hall, St. Austell, by Messrs. Viner, Carew and Co., of Plymouth, in conjunction with Messrs. Tresidder and Co., of London. The solicitors were Messrs. Coodes and Giffard, of St. Austell.

Duporth, which is situated about 1½ miles from St. Austell, within half a mile from the village and China Clay port of Charlestown, 15 miles from Truro, and 6 miles from Fowey, consists of a fine old Georgian residence of modern size, an excellent home farm, and about 30 acres of land, the whole property comprising a little over 93 acres. The property is on the sea coast, and enjoys beautiful views of the St. Austell bay; the estate also includes the private beach of Duporth.

The first bid was of £4,500. The price rose between three bidders from this figure to £7,750, when the property was withdrawn. Negotiations were entered into immediately after the sale, however, and the property purchased privately by Mr. Walter Sessions, who is one of the managing directors of English China Clays, Ltd., for £8,250.

Why Not Cornwall for Cotton Mills and Potteries?

Why is cotton manufactured in Lancashire, although the raw material has to cross the sea, and the China Clay used for the bleaching and filling of cotton goods has to be transported all the way from Cornwall and Devon? Why is crockery made in North Staffordshire, although the clay from which all the finer ware is made has to be brought from Cornwall and Devon?

The main reasons why great manufacturing towns spring up in certain areas is the near presence of coal. The rise of the cotton industry in South Lancashire would not have taken place but for the coal field, but even the presence of vast stores of "black diamonds" would have been unavailing had not Lancashire been one of the wettest and most humid counties in England, in which respect it compares with Cornwall.

This is shown even in Lancashire itself when the dry east winds of spring prevail, for then spinning is said to be "bad." The spinner has more trouble in five minutes during east wind weather than in an hour when the wind blows from the west.

In North Staffordshire only the coarsest clay is found, and that undoubtedly laid the foundations of the towns which to-day are known as the Potteries. But Josiah Wedgwood would never have made a fortune from the "crocks and pots" which this coarse clay produces. The clay for the beautiful things must be brought from Cornwall, Devon and Dorset. Why, then, are not the potteries and cotton mills there? It is probably because it is more economical to carry the clay from Cornwall to Staffordshire and Lancashire, where the coal is, than to carry the coal to Cornwall, where the clay is, and thus the potteries and cotton mills are 300 miles from their source of supply of the raw materials in which they work.

Shipping and Export News of the Month

We give below the latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—October, 1924

Arrived.	Name.	Sailed.	Destination.
Oct. 1, S.S.	*Reedness*	Oct. 7,	London
Oct. 1, S.S.	*Kynite*	Oct. 8,	Bo'ness
Oct. 1, S.S.	*Berkelstroom*	Oct. 9,	Amsterdam
Oct. 2, S.S.	*Avanville*	Oct. 9,	Preston
Oct. 2, S.S.	*Silva*	Oct. 9,	Wargan
Oct. 3, S.S.	*Clyde Valley*	Oct. 10,	Preston
Oct. 3, S.S.	*Ualan*	Oct. 10,	Bilbao
Oct. 5, S.S.	*Brier Rose*	Oct. 11,	Grimsby
Oct. 5,	*Hansea*	Oct. 16,	Hamburg
Oct. 5,	*My Lady*	Oct. 11,	Pentewan
Oct. 5, S.S.	*Isabella*	Oct. 10,	Antwerp
Oct. 7, S.S.	*Orleigh*	Oct. 10,	Hull
Oct. 8, S.S.	*Westdale*	Oct. 11,	Birkenhead
Oct. 9, S.S.	*System*	Oct. 13,	Rouen
Oct. 9, S.S.	*Marta*	Oct. 13,	Gothenborg
Oct. 9, S.S.	*Herfinn*	Oct. 15,	Skien
Oct. 9, S.S.	*Coral*	Oct. 15,	Runcorn
Oct. 9, S.S.	*Mellanear*	Oct. 15,	Antwerp
Oct. 10, S.S.	*Onega*	Oct. 14,	New York
Oct. 10, S.S.	*Cape Ortegal*	Oct. 22,	Philadelphia
Oct. 10,	*Milano*	Nov. 4,	Genoa
Oct. 10, S.S.	*Pylades*	Oct. 18,	Tayport
Oct. 11, M.V.	*Jupiter*	Oct. 16,	Oscarsham
Oct. 12, M.V.	*Alfa*	Oct. 16,	Raums.
Oct. 12, S.S.	*Florentino*	Oct. 16,	Genoa
Oct. 12, S.S.	*Estella*	Oct. 18,	Brussels
Oct. 12,	*Else*	Oct. 28,	Gothenborg
Oct. 13, S.S.	*T. W. Stewart*	Oct. 15,	Charlestown
Oct. 13, S.S.	*Penthaw*	Oct. 24,	Portland, Me.
Oct. 13, S.S.	*Bangor*	Oct. 18,	Newcastle
Oct. 13, M.V.	*Harjumaa*	Oct. 18,	Norrkoping
Oct. 14, M.V.	*Worry Not*	Oct. 20,	Rochester
Oct. 14,	*Mary Watkinson*	Nov. 5,	Weston Point
Oct. 14, S.S.	*Overton*	Oct. 18,	Liverpool
Oct. 15, S.S.	*Foy*	Oct. 22,	Antwerp
Oct. 15, S.S.	*Hayle*	Oct. 18,	Ridham
Oct. 15, S.S.	*Mayfield*	Oct. 21,	Rouen
Oct. 15, S.S.	*Pamela*	Oct. 21,	Garston
Oct. 15, S.S.	*Crowmell*	Oct. 21,	Fleetwood
Oct. 15, S.S.	*Spaarnestroom*	Oct. 22,	Amsterdam
Oct. 15, M.V.	*Lydia Cardell*		*
Oct. 16, S.S.	*Kenrhos*	Oct. 22,	Antwerp
Oct. 16, S.S.	*Yewglen*	Oct. 22,	Runcorn
Oct. 16, S.S.	*Siri*	Oct. 23,	Drammen
Oct. 17, S.S.	*Vilvorde Maritime*	Oct. 23,	Brussels
Oct. 18, M.V.	*Hele Naval*	Oct. 24,	Hamburg
Oct. 18, S.S.	*Tyr*	Oct. 27,	Kotka
Oct. 18, S.S.	*Pansy*	Oct. 22,	Rouen
Oct. 18,	*Leif*	Oct. 27,	Charlestown
Oct. 18,	*Irish Minstrel*	Nov. 5,	Runcorn
Oct. 18, S.S.	*Bruxelles Maritime*	Oct. 24,	Brussels
Oct. 19, S.S.	*Brier Rose*	Oct. 27,	Manchester
Oct. 19, S.S.	*Ualan*	Oct. 20,	Charlestown
Oct. 19, S.S.	*Shoreham*	Oct. 25,	Preston
Oct. 21, M.V.	*Anna Kirstine*	Oct. 21,	Boston, Lincs
Oct. 21, S.S.	*Wimbledon*	Nov. 4,	Philadelpha
Oct. 21, S.S.	*Ribera*	Nov. 2,	Philadelphia
Oct. 22, S.S.	*Ferndene*	Oct. 29,	Antwerp
Oct. 22, S.S.	*Shellie*	Oct. 23,	Fleetwood
Oct. 22, M.V.	*Wirumaa*	Oct. 29,	Trangsund
Oct. 22, S.S.	*Abercraig*	Oct. 25,	Preston
Oct. 22, M.V.	*Agnes Craig*	Nov. 5,	Rochester
Oct. 24,	*John Simms*	Oct. 26,	Par
Oct. 24, M.V.	*Fridius*	Oct. 29,	Drammen
Oct. 25, S.S.	*Isabella*	Oct. 25,	Charlestown
Oct. 25, S.S.	*Berkelstroom*	Nov. 4,	Amsterdam
Oct. 25, S.S.	*Falmouth Castle*	Oct. 29,	Weston Point
Oct. 26, S.S.	*Allan*	Nov. 4,	Genoa
Oct. 27,	*Water Witch*	Nov. 5,	Preston
Oct. 29, S.S.	*Nephrite*	Nov. 4,	Bo'ness
Oct. 29, S.S.	*Dragoon*	Nov. 1,	Liverpool
Oct. 31,	*Louise*		*
Oct. 31, S.S.	*Urpeth*	Nov. 5,	Brussels

Charlestown Shipping—October, 1924

Arrivals

Date.	Vessel.	From
Sept. 30	*Alberta*	Plymouth
Oct. 1	*Mary Barrow*	Fowey
Oct. 3	*Treleigh*	Portreath
Oct. 4	*Mystery*	Exmouth
Oct. 6	*Worrynot*	Plymouth
Oct. 12	*Windermere*	Truro
Oct. 14	*Katie*	Par
Oct. 15	*T. W. Stuart*	Fowey
Oct. 16	*Treleigh*	Cardiff
Oct. 16	*Snow Queen*	Port Talbot
Oct. 17	*Alberta*	Goole
Oct. 17	*Waterwitch*	Falmouth
Oct. 17	*Paquerette*	Rochefort
Oct. 18	*Rose*	Gweek
Oct. 20	*Nalan*	Pasages
Oct. 20	*Amaga*	Stromfors
Oct. 27	*Lief*	Revel

Sailings

Date.	Vessel.	Destination.
Oct. 4	*Alberta*	Antwerp
Oct. 4	*Treleigh*	Preston
Oct. 4	*Mary Barrow*	London
Oct. 17	*Mystery*	Boulogne
Oct. 17	*Worrynot*	Rochester
Oct. 17	*Windermere*	Rochester
Oct. 17	*Katie*	London
Oct. 17	*T. W. Stuart*	London
Oct. 17	*Snow Queen*	Barrow
Oct. 18	*Treleigh*	Preston
Oct. 18	*Alberta*	Brussels
Oct. 25	*Elizabetta*	Fleetwood
Oct. 25	*Magrie*	Antwerp
Oct. 26	*Nalan*	Brussels
Oct. 27	*Waterwitch*	Preston
Oct. 30	*Rose*	London
Oct. 30	*Miriam Thomas*	Preston
Oct. 30	*Isabella*	Terneuzen
Oct. 31	*Paquerette*	Nantes

Par Harbour Shipping—October, 1924

Arrivals

Date	Vessel	From
Oct. 1, S.S.	*James Tennant*	Weymouth
Oct. 6, S.V.	*Shortest Day*	Port Houstock
Oct. 8, S.V.	*J. H. Barrow*	Port Leven
Oct. 9, S.V.	*Henrietta*	Penarth
Oct. 10, S.S.	*Coniston*	Dublin
Oct. 11, M.S.	*Lee Lea*	Teignmouth
Oct. 11, S.S.	*Triumph*	Port Houstock
Oct. 15, S.S.	*Robrix*	Teignmouth
Oct. 16, S.S.	*Velocity*	Newport
Oct. 17, S.V.	*Amanda*	Runcorn
Oct. 18, S.V.	*The Sirdar*	Port Houstock
Oct. 19, S.V.	*Snowflake*	Runcorn
Oct. 20, S.V.	*W. E. Gladstone*	Port Houstock
Oct. 22, S.V.	*Lord Devon*	Mevagissey
Oct. 23, S.S.	*Cromarty Firth*	Southampton
Oct. 25, S.S.	*Norrix*	Exeter
Oct. 25, S.S.	*Bangor*	Newcastle
Oct. 26, S.S.	*Palmston*	Plymouth
Oct. 26, S.V.	*John Sims*	Runcorn
Oct. 27, S.V.	*Hosianna*	Falmouth
Oct. 27, S.V.	*Lady Agnes*	Port Houstock
Oct. 27, M.V.	*Hetty*	Falmouth
Oct. 28, S.V.	*Fanny Crossfield*	Falmouth
Oct. 28, S.V.	*Albert*	Dingle (Ireland)

Sailings

Date	Vessel	Destination
Oct. 1, S.S.	*Rose*	Lancaster
Oct. 1, S.V.	*Winifred*	Pentewan
Oct. 1, S.V.	*J.N.R.*	Pentewan
Oct. 2, S.S.	*James Tennant*	London
Oct. 2, S.S.	*Ferrum*	Fleetwood
Oct. 2, S.S.	*Pamela*	Preston
Oct. 3, S.V.	*Gwendoline*	Plymouth
Oct. 13, S.V.	*Margarette West*	Poole

Oct. 14, S.V.	*Rothersand*	Runcorn
Oct. 15, S.V.	*Shortest Day*	Pentewan
Oct. 15, S.S.	*Coniston*	Antwerp
Oct. 15, S.S.	*Lee Lee*	Gravelines
Oct. 16, S.S.	*Robrix*	Gravesend
Oct. 17, S.S.	*Velocity*	Newlyn
Oct. 20, S.S.	*Triumph*	Plymouth
Oct. 22, S.V.	*The Sirdar*	Pentewan
Oct. 22, S.V.	*W. E. Gladstone*	Pentewan
Oct. 27, S.S.	*Cromarty Firth*	Preston
Oct. 28, S.S.	*Bangor*	Plymouth
Oct. 31, S.V.	*Snowflake*	Runcorn
Oct. 31, S.V.	*Lord Devon*	London
Oct. 31, S.S.	*Norrix*	Grimsby
Oct. 31, S.V.	*J. H. Barrow*	Newcastle

Par Harbour Tide Table, November, 1924

(Greenwich Mean Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Saturday	1	7.50	8.13	13. 0
SUNDAY	2	8.35	9. 0	12. 4
Monday	3	9.27	9.55	11. 6
Tuesday	4	10.29	11. 8	10.11
Wednesday	5	11.15	—	10.10
Thursday	6	0.33	1.22	11. 0
Friday	7	1.50	2.24	11. 6
Saturday	8	2.54	3.22	12. 0
SUNDAY	9	3.45	4. 7	12. 5
Monday	10	4.28	4.48	12. 8
Tuesday	11	5. 6	5.25	12. 9
Wednesday	12	5.43	6. 1	12. 9
Thursday	13	6.17	6.32	12. 8
Friday	14	6.46	7. 1	12. 4
Saturday	15	7.16	7.33	11.10
SUNDAY	16	7.50	8. 4	11. 6
Monday	17	8.22	8.41	11. 1
Tuesday	18	9. 2	9.25	10. 8
Wednesday	19	9.49	10.19	10. 4
Thursday	20	10.50	11.29	9.11
Friday	21	—	0. 8	10. 0
Saturday	22	0.47	1.24	10. 7
SUNDAY	23	1.55	2.24	11. 4
Monday	24	2.53	3.18	12. 3
Tuesday	25	3.43	4. 7	13. 1
Wednesday	26	4.31	4.55	13. 8
Thursday	27	5.18	5.44	14. 0
Friday	28	6. 8	6.31	14. 0
Saturday	29	6.55	7.15	14. 0
SUNDAY	30	7.38	8. 4	13. 6

E. CLEMENS, Harbour Master.

China Clay Exports

RETURN showing the exports of China Clay, the produce or manufacture of the United Kingdom from the United Kingdom to each country of destination, registered during the month ended October 31, 1924 :—

Country of Destination.	Quantity. Tons.	Value. £.
Finland	3,184	6,978
Sweden	2,501	3,819
Norway	9,976	19,335
Denmark	634	1,819
Germany	1,543	4,552
Netherlands	1,892	4,926
Java	100	405
Belgium	6,316	11,332
France	3,205	5,599
Spain	2,264	7,127
Italy	2,319	6,348
Greece	5	20
China	26	136
United States of America	27,768	58,862
Mexico	70	280
Colombia	1	6
Chile	25	111
Brazil	21	95
Argentine Republic	216	900
Channel Islands	210	473
Bombay via other ports	3,607	13,951
Madras	1	6
Bengal	252	858
Straits Settlements	3	15
Malay States : Federated	2	12
Victoria	5	20
New South Wales	1	7
New Zealand	6	26
Canada	195	1,023
Total	66,348	£149,041

October Deliveries

FOLLOWING the rush of orders consequent upon the break-up of the Producers' Association in September, demand slackened to some extent in October, the ratio of increased deliveries, while over 6,000 tons greater than in September, did not show such a great margin of increase over the previous month as was the case in September. Nevertheless the volume of trade done was very substantial, but so far as China Clay and china stone was concerned, each total failed to reach the record monthly total for the year, namely, 84,370 tons in May. China stone and ball clay each showed a falling off from the totals of the previous month.

An analysis of the total trade done in the ten months ended October reveals a very substantial increase on the total trade for the corresponding ten months of last year, the increased tonnage in favour of this year on the three classes, China Clay, china stone and ball clay being over 73,000 tons, China Clay showing the biggest increase with over 50,000 tons, ball clay coming next with over 13,000 tons, and china stone next with over 10,000 tons.

The channels through which October deliveries were made are :—

Monthly Figures

	China Clay Tons	China Stone Tons	Ball Clay Tons	Total Tons
Fowey	64,037	3,583	2,708	70,328
Par	3,876	100	—	3,976
Charlestown	5,597	—	—	5,597
Plymouth	1,567	10	113	1,690
By rail	5,120	—	—	5,120
October totals	80,197	3,693	2,821	86,711
September totals	74,157	4,368	3,342	81,868
August totals	61,681	5,903	1,970	69,554

Ten Months' Figures

Comparative figures showing total deliveries for ten months 1924—1923 :—

China Clay Tons		China Stone Tons		Ball Clay Tons		Total Tons	
1924	1923	1924	1923	1924	1923	1924	1923
671,843	621,737	43,602	32,857	31,275	18,202	746,720	672,796

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

BOWATER'S PAPER MILLS, LTD., London, E.C. Registered October 19, £175,000 second debenture stock, secured by Trust Deed dated September 29, 1924 (subject to first debenture stock) ; charged on Northfleet Dock Yard, Northfleet, also general charge.

WADDINGTON (J. H.) AND CO., LTD., Brighton, paper manufacturers. Registered September 29, £7,000 debentures (secured by Trust Deed dated September 10, 1924), present issue £100 ; charged on properties at Beighton, also general charge. *Nil. April 30, 1924.

London Gazette, &c.

Company Winding Up Voluntarily

ASSOCIATED CHINA CLAYS, LTD. D. H. Allan, 4, Fenchurch Avenue, London, chartered accountant, appointed liquidator October 15.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., 8, Bouverie Street, London, E.C.4. All communications relating to Advertisements, Subscriptions and other business should be sent to the Manager, "The China Clay Trade Review," at the same address. Telegrams—"Allangas, Fleet, London." Telephone—City 9852 (6 lines).

Contents

	PAGE
EDITORIAL NOTES	7
Value of American Clay Discussed	8
The Future of Fowey	9
Silica and Alumina	10-11
China Clay Uses	11
China Clay in Tinted Papers	14-15
China Clay in Canada	15
China Clay Notes and News	16-17-18
Shipping and Export News of the Month	19
Commercial Intelligence	20

October China Clay Trade

THE figures ot the China Clay trade in October showed the substantial increase of 6,000 tons on September, but the rate of increase was not so great as was that of September over the preceding month. The month's total tonnage compared with the preceding months was :—China Clay, 80,197, 74,157, 61,681 ; china stone, 3,693, 4,368, 5,903 ; ball clay, 2,821, 3,342, 1,970. Total for all classes :—October, 86,711 ; September, 81,868 ; August, 69,554. October's tonnages were despatched as follows :—Fowey : China Clay, 64,037 ; china stone, 3,583 ; ball clay, 2,708—total, 70,328. Charlestown : China Clay, 5,597. Par : China Clay, 3,876 ; china stone, 100—total, 3,976. Plymouth : China Clay, 1,567 ; china stone, 10 ; ball clay, 113—total, 1,690. In addition, 5,120 tons were sent by rail. The tonnages dealt with for the ten months of this year have been substantially in excess of the corresponding period last year, as the following comparative figures show. In each case this year's figures are given first :—China Clay, 671,857, 621,737 ; china stone, 43,602, 32,857 ; ball clay, 31,275, 18,202—totals, 746,720, 672,796. Excess in favour of this year, 73,924 tons. If we could say that with this increased tonnage an increased amount of revenue was accruing to the Chian Clay areas it would be welcome news indeed, but, unfortunately, owing to the collapse in prices, the evidence points to the revenue this year being less on a greatly increased tonnage than it was last year.

It is noted with regret that the foreigner is getting the benefit at the expense of the people who produce the China Clay, for in October there was a jump in the exports over September of nearly 20,000 tons, the total having been 66,348 tons against 47,604 tons. The United States of America took the bulk with 27,768 tons, against 21,599, the other chief increased tonnages being taken by Belgium, 6,316, compared with 3,421 ; Norway, 9,976, compared with 2,305. Increases were also recorded in the case of Finland, India, Germany, and Sweden. So far the prices of common clays have not hardened to any appreciable extent, but producers are still feeling acutely the slump in prices following the dissolution of the Association.

China Clay in 1924

FROM the point of view of volume of trade, the statistics available so far for the year point to 1924 being one of the best years experienced since the war, if it does not, in fact, come up to the "boom" year of 1920. Unfortunately, the increased volume has been secured at the expense of price, large quantities of the China Clay that has been dispatched since the Producers' Association broke up in mid-September having been disposed of at prices that left very little margin of profit. From all accounts, the figures at which buyers have recently been making contracts for the early part of next year the trade outlook, from the point of view of profit, is not encouraging.

Though some people have been disposed to criticise the now defunct Producers' Association, these same people seem to have overlooked the fact that its policy was nothing more than that underlying the Safeguarding of Industries Act, the only difference being that its application applied to one industry only which suffers from economical causes resulting from the war, instead of to different industries. That is to say, that while some critics support the principle of the Safeguarding of Industries Act when applied politically, they object to the same principle when applied to their own industry. It must always be borne in mind that the Producers' Association was an artificial method of counterbalancing the effects of abnormal post-war conditions and circumstances, so that producers could ensure satisfactory remunerative returns which, since the break-up of the Association, they have not been able to obtain.

In any case, the tendency from now onward should be a hardening of prices, as producers are already beginning to realise that the average of prices that have ruled since the break-up of the Association cannot continue if the firms concerned are to carry on their works on a profitable basis.

Christmas Wishes

A GOOD many years have passed since in the first Christmas number of THE CHINA CLAY TRADE REVIEW we had the pleasure of wishing our readers the time-honoured, but none the less sincere, "Compliments of the Season."

The trade has seen some prosperous years, but more lean ones, since the commencement of the REVIEW, and at the moment of writing, with the break-up of the Association and the ruinous price-cutting war, it cannot be said to be in the happy position which it is the desire of all those who have its real interest at heart to see.

There are nevetheless signs that the trade has realised the benefits of the Association in the past, and its break-up has perhaps done more to open the eyes of its late members to its many advantages than anything else could have done.

It is to be hoped that an Association may be speedily re-formed, to the rules of which members of the trade may conform, so that harmony may reign and prices become stabilised, to the good of the trade as a whole.

The late Association has never in any sense profiteered—its sole object was to prevent the price-cutting which now exists, and which must inevitably mean the closing down sooner or later of some of the firms not so well equipped to withstand such a policy.

The figures which we have published monthly show that a greater volume of clay has been sold, but the prices have shown a very great reduction, and much of the clay sold must have been sold below cost of production.

There can only be one end to such a policy, and it is the earnest desire of everyone who really wishes the trade well, to see an end of such a proceeding, and the New Year bring a sounder and saner working arrangement amongst the members of so important an industry.

Value of American Clay Discussed

THE following article, which appeared in the American magazine *Paper*, will be read with great interest by English China Clay producers, as showing the determined efforts now being made by American producers to oust English clays from the U.S.A. market.

English producers will not agree with much of the article, but it goes to show the necessity of propaganda work in U.S.A., and even more effort on the part of English producers, if this valuable market is to be retained.

The writer, Mr. Geo. K. Spence, of New York and Pennsylvania Company, says :—

Down to a comparatively recent period, paper manufacturers were quite sceptical about the value of domestic clays for the various uses to which papermaking clay is put. It was generally held that if satisfactory results were to be obtained, foreign clay only must be used. This feeling was so prevalent that the domestic clays were not given a fair trial, nor the domestic clay producers sufficient encouragement to warrant the development of the product to such an extent that it could compete with foreign clays then on the market. The same has been true of every new raw material, or new process, that has been introduced to the pulp and paper industry.

In the same way, about twenty years ago the pulp manufacturer thought it was next to impossible to use other than English Pilkington bleaching powder to procure proper bleaching results. When Arnold Hoffman and other companies tried to market domestic bleaching powder, years elapsed before the pulp manufacturers became convinced that they could save money, and get equally good results with the use of domestic bleaching powder.

This old attitude of scepticism concerning the value of domestic clay had resulted until recently in keeping up the price of foreign clay. Now paper manufacturers are beginning to realise that very satisfactory results can be obtained by the use of high grade domestic clay.

English and American Clays

On several occasions the writer has made comparative tests of English clays and domestic clays by running a series of retention tests on various weight papers. An all-English clay was used on a bone-dry weight basis, and a duplicate series of tests were made with the use of an all-domestic clay on a bone-dry weight basis. The comparative tests have never failed to show that domestic clay is retained in the sheet of paper to an equal extent with English clay. The finish of the two sheets has been the same, whether English or domestic clay was used.

Following are results of analyses made recently on one sample of English clay and two samples of domestic clay :

	English Clay.	South Carolina Clay.	Virginia Clay.
Specific gravity	2·64	2·63	2·59
Moisture	8·04%	·70%	5·85%
Combined water	11·16%	13·64%	13·20%
Silica	42·52%	54·48%	43·01%
Aluminum oxide	36·36%	39·20%	37·01%
Iron oxide	1·18%	·62%	·61%
Calcium oxide	·36%	·18%	·32%
Magnesium oxide	·38%	·13%	Trace

The South Carolina sample contained very little moisture, due no doubt to the sample having been kept in the laboratory for a period of time before being tested. However, some high grade domestic clay comes to the mill with a moisture content as low as 1 per cent., indeed as a general rule the average moisture content of domestic clay is considerably lower than the average moisture content of foreign clay as received at the mill.

Plasticity tests showed both of the domestic clays to be more plastic than the English clay.

The proportion of colloidal clay in the Virginia sample was the same as that found in the English sample, while that present in the South Carolina clay was slightly in excess of that noted in the other two clays.

A screening test does not give relative values of clays in regard to proportion of gritty substance present, neither does the elutriation test give dependable results. Material that passes through an extremely fine mesh sieve will often be found to be very gritty ; while on the other hand, materials caught on a comparatively coarse screen often contain certain particles which are not at all gritty. The elutriation apparatus will not wash the gritty particles free from the adhering sticky clay and it is necessary to remove it from time to time, rub with a policeman and return it to the apparatus, otherwise the results will nor represent the true value of the clay.

Decantation Method

The one-minute decantation method has been found to give comparable results, and has been used in the writer's laboratory for several years. This method consists in mixing thoroughly 50 grams of clay in a 600 c.c. beaker with water, using a policeman, allowing to settle for one minute and decanting the cloudy supernatant liquid. The beaker is then filled with water and the contents thoroughly mixed, after which it is allowed to settle for one minute and again decanted. This is repeated until the water above the gritty substance remains perfectly clear after settling for one minute. The gritty substance is then thrown on an ashless filter paper, ignited and weighed. The weight in grams multiplied by two will give the percentage of heavy gritty substance. If the clay is refractory and difficult to wash it will be of considerable assistance to boil in with water a couple of times during the decantation.

By the one-minute decantation method the three clays under examination gave following results : English clay ·08 per cent. ; Virginia clay ·09 per cent. ; South Carolina clay ·11 per cent. heavy gritty substance.

The grit test supplemented by a test for abrasiveness gives practically the same results, as all three clays are non-abrasive.

The Colour of Clays

The colour of the English clay was slightly superior to either of the domestic clays tested, and no artificial colouring matter was detected in any one of them. Some finished English clays appear to be of much better colour than domestic clays ; but in their natural state the colour is no better. In order to disguise the low colour, artificial blueing is added while mining the clay ; and the consumer uses the clay thinking it to be in its natural state. The clay producers have taken advantage of the fact that few paper manufacturers or testing laboratories have been able to detect the presence of artificial blueing even when added in liberal quantities.

A method for detecting artificial blueing in clay was contributed by the writer to the *Dyestuff Reporter* of December 3, 1923, its title being, "Effect of Artificially Coloured Clay on Fast to Light Paper." This method will expose artificial blueing when present in quantities as minute as ·002 per cent. It consists in the mixing 25 grams of clay to a heavy paste with water in a No. 1 tall form beaker, adding 3 c.c. of ·90 specific gravity ammonium hydroxide, mixing thoroughly, and placing the beaker on a steam bath or drying oven until the odour of ammonia is completely expelled. When the clay containing artificial blueing becomes dry a brown colouration appears on top as long as any odour of ammonia remains ; but as soon as all odour of ammonia is dissipated the brown colouration changes to a distinct blue or redish blue, depending upon the nature of the dye used. This method has been in use in the laboratory of the writer for a number of years and has been the means of adjustments on or rejection of a great many cars of foreign clay.

There is no serious objection to artificial colouring matter in clay ; but it is advisable for the paper manufacturer to do his own compounding, and he should receive the clay in its natural state. If he desires a higher colour than that of the natural clay at hand, he can, when mixing the clay for use, add the proper dye for the purpose intended. If a fast to light paper is desired, a fast to light dye can be used to tint the clay, while on the other hand if the sheet is tinted with a dye which is not fast to light the same dye can be used to tint the clays. A paper manufacturer is greatly handicapped when using in a fast to light sheet of paper a clay which has been previously tinted with a cheap dye.

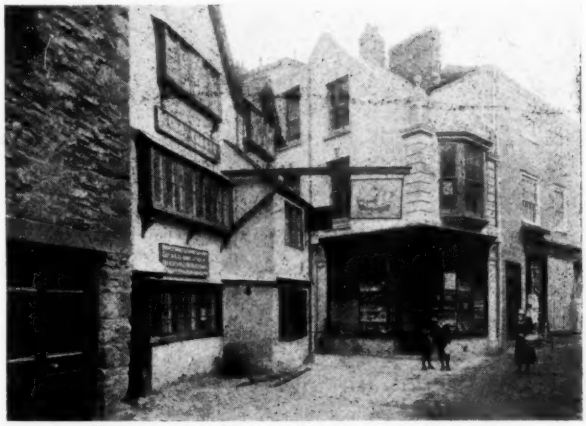
It may be said in conclusion a good grade of domestic clay will give equally as good results in the manufacture of paper as foreign clay, with the exception of colour, and the colour can be matched closely at a nominal cost. Paper manufacturers are, therefore, justified in taking their present stand regarding the use of domestic clay.

The Future of Fowey

China Clay Trade's Chief Port

On the occasion of the election of Mr. George Varco, Jnr., as Mayor of Fowey—a prominent local tradesman and the father of one of Aston Villa Football Club's most promising young players—the Alderman, Councillors and representative men associated with the public and commercial life of Fowey were entertained to luncheon at the Fowey Hotel.

Canon H. N. Purcell submitted "Prosperity to the Borough," and compared the Fowey of to-day with its pitiable condition when he first came to Fowey as an undergraduate from Oxford. He congratulated Fowey on its prosperity, and hoped that that prosperity by the blessing of God would materially increase. Those in authority in the borough of Fowey had a very great inheritance, as historic as any place they could find. One of the finest things in his lifetime that had happened in Fowey was the restoration of its ancient charter in 1913. He had often thought that one of their learned ones should write a history of Fowey, and no one was more capable of doing that than Dr. Cann, their M.O., who could tell them more about Fowey than any other man.



One of the Quaint Streets at Fowey.

Responding, Councillor C. J. Mitchell predicted that there would be more development and progress in Fowey during the next five years than there had been for 25 years. The amount of money the G.W.R. had spent at Fowey no one outside the G.W.R. knew; they had admitted £80,000 on the new jetty for rating purposes, but there was a considerable amount of money spent on that job that would not be stated at all. The G.W.R. had spent all that money because they believed in the future of Fowey, and to make provision for the shipment of China Clay which they anticipated would be increased in the years to come. The Harbour Commissioners had spent a considerable amount of money in improving the harbour, and visitors were being catered for in various ways, and in this direction Councillor Mitchell referred to the generous gift of a recreation ground by one of its sons, Col. Treffry. He also referred to important facilities for housing, the improvements the Council were making in their water supply and other things, and to the provision of educational facilities as factors in the future prosperity of Fowey.

Old No. 4 Jetty before Conveyor was built, Fowey.

Alderman Shadwell submitted the toast of "The Mayor," and referred to the public services Councillor Varco had rendered his native town.

Acknowledging, the Mayor said what a pleasure it was to him to meet so many of his friends on that occasion. He referred to the growth of Fowey in the last 40 years, and expressed the hope that with their new water supply Fowey would prosper and that provision would be made for housing the working classes, so that instead of only a third of the money being paid in wages being spent in Fowey, the whole of it would be. He was more optimistic about their water supply than Councillor Mitchell, and believed that when they had that and drainage in operation a great impetus would be given to the prosperity of Fowey.

Sir Quiller Couch's House, Fowey.

The New Mayor

Councillor Varco, the new Mayor, has had a long association with the public life of Fowey. He joined the parish Council in 1907, when only 32, an example to the younger men of the present day. When the Parish Council was superseded by the Borough Council the retiring Mayor was chairman and the new Mayor vice-chairman. He was one of the first members of the Borough Council, and has served on various committees, and been for two years chairman of the Water Committee. Among his other activities has been his management of the elementary and secondary schools in the district, his chairmanship of the Institute Committee, into which he instilled new life, and his endeavours while associated with the gas company to give Fowey more light.

Housing China Clay Jettymen

There seem to be substantial grounds for the belief expressed by Councillor Mitchell that the next five years will witness great strides in the development of the Borough and Port of Fowey. Since Fowey regained its ancient charter in 1913 it has been very severely handicapped by the lack of an adequate water supply, the demands on it having been such, particularly in the summer, that China Clay vessels requiring

water have had to leave to obtain it from other places. The Council, realising the importance of adequate supplies of water in the encouragement of building, recently embarked on ambitious schemes, one to supply the jetties and the other to supply the domestic requirements of Fowey. With the facilities now available for the acquisition of suitable building sites, there is now a good deal more building activity going on at Fowey than has been the case for many years. That there is need for many houses to meet the needs of the men working on the China Clay jetties is seen in the fact that at the present time something like two-thirds of the men employed on the jetties have now to travel to and from their work through lack of adequate housing accommodation in Fowey itself. To provide for these people in Fowey would, as the Mayor pointed out, add considerably to the business of Fowey.

As regards visitors, Fowey is becoming an increasingly attractive holiday resort, and in laying out the recreation ground, generously presented to the town by Col. E. Treffry (Fowey's new squire), amenities for visitors will be added to as well as those for the inhabitants.

On the commercial side Fowey has a splendid asset in China Clay shipping, while its beautiful estuary provides innumerable attractions for visitors. With the incentive the Fowey Town Council seems willing to give to private enterprise in its development, in the way of subsidies for housing, drainage, water, and other services, there is no reason why the prophecy of Councillor Mitchell as to the rapid growth of Fowey in the near future should not be fulfilled.

Silica and Alumina

A Survey of Alumina and its Peculiarities

ALUMINA is an oxide of aluminium, and is found in some countries as small, round or kidney-shaped lumps, to which the name aluminite has been given. In this form it is usually associated with some sulphuric acid, and is, therefore, *partly* alumina sulphate. It also occurs as an earthy deposit, stained yellow, brown or reddish by iron oxide of varying chemical degrees and strength. It can readily be separated from China Clay ; but is preferably prepared, experimentally, by dissolving alum, or an aluminous salt, in water, and then adding to it a solution of either caustic soda, caustic potash, excess soda carbonate, or excess ammonia, or ammonia carbonate. Effervescence, caused by the escape of the gas carbon dioxide, is manifested meantime if carbonate is used. There is no such thing as carbonate of alumina ; hence the gas cannot combine with the alumina.

The resultant reactions in this process yield a bulky white deposit of alumina hydrate (this is also known as alumina hydroxide), which has to be removed, washed, dried, and made red-hot to convert it into alumina. Alumina hydrate is acidic in its reactions.

Freshly precipitated alumina hydrate is colloidal or gelatinous, and is then soluble in dilute acids, and is distinguished as hydrosol. On standing undisturbed for a while, however, or when boiled or otherwise concentrated, it becomes less soluble in acids, and finally can be solidified, when it is termed hydrogel. When completely modified in this direction it cannot be dissolved in acids to any extent.

After the hydrate has been raised to a red heat for some time it becomes changed into the oxide or alumina. At this stage it will be advisable to say a few words about the metal aluminium, which is derivable from alumina, clays, and kindred substances. A consideration of the process involved in its manufacture hardly comes within my present purview ; but it should be pointed out that when alumina is strongly heated it is (according to the length of treatment) either coated with a white crust of, or entirely modified by oxidation into, alumina. Although the atmosphere has hardly any effect on the metal, long exposure of it, unused, gradually produces a thin protective film upon it, which is almost transparent and consists of alumina.

Alumina is expressed as Al_2O_3, and is a compound of oxygen with the element aluminium. It is one of the most abundant constituents of the earth, and is the essential component of corundum or emery, and rubies and sapphires, the last two stones being coloured respectively red and blue by means of chromium and cobalt compounds. When it is quite pure alumina is opaque white, but it may be greyish, yellowish, brownish or redish, or a mixture of these shades, through the presence of foreign matter. Three forms of hydrated alumina—that is, containing some *chemically combined* water—occur in nature as hydrargillite, bauxite and diaspore respectively. Many artificial gems are made by fusing alumina with the oxyhydrogen blowpipe flame. Alumina is used to some extent in pottery glazes, and is added to special classes of fireclay to increase the value of bricks. Alum, alumina, and alumina sulphate are used in the manufacture of leather. Alumina hydrate is used in several house, etc., painting processes. Felspar often contains alumina, due to its partial conversion into China Clay while accompanied by other minerals. It is believed in many quarters that the intense blueness of ultramarine, which is made by baking together China Clay, sand, sulphur and rosin, is evolved primarily by the alumina content.

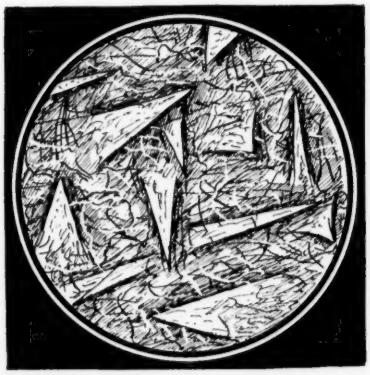
Alum

With the help of alumina salts, mixed with *organic* dyestuffs, brilliantly coloured lakes or pigments, widely used in the dyeing industry, are prepared. Alum is so closely associated with alumina that it deserves to be described. To make it, add one ounce of sulphuric acid and one ounce of water to two ounces of finely powdered China Clay and keep the mixture for several weeks in a warm place, stirring it occasionally with a glass rod. Then dilute it with six ounces of boiling water, and strain it through linen, whereby the silica is left on the fabric. The liquor contains alumina sulphate ; and when it is evaporated to one and a half ounces lustrous pearly crystalline plates of the salt separate out. They are very dilequescent, and when exposed to the air attract moisture to themselves and dissolve in it. The liquor is decanted from the crystals, which are re-dissolved in water, from which they re-crystallize in a purer condition. They are recoverable by continued decantation. By dissolving the refined crystals of alumina sulphate in hot water, and adding a solution of potash sulphate thereto, and then stirring the solution until it becomes cold, a white deposit of amorphous alum powder is formed. When the clear liquor is poured away from this precipitate, and it is re-dissolved in hot water, and subsequently cooled at a slow rate, beautiful octahedral crystals of pure alum appear. Alum is expressed as $K_2SO_4Al_2(SO_4)_324H_2O$. Crude alum is procured by roasting, and then watering, alum shales, alum stone, or alum ore, which are found, contaminated with pyrites, in many countries. The reactions which ensue during this procedure are too technical and complicated to be satisfactorily described in the space at my disposal ; but, finally, alumina sulphate results ; and when potash sulphate is added to this product (as above outlined) alum is formed. Alumina sulphate, obtained by evaporating the solution without potash, etc., until a solid only remains, is often used direct in some industries, especially in paper-making.

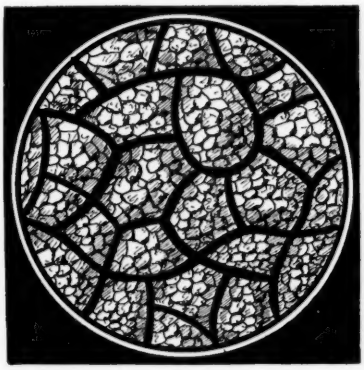
Uses as Loaders

Three grades of alumina sulphate are used as loaders for paper, known as best, hard white, and semi-opaque. The percentage of iron is greatest in the third, and practically too insignificant for calculation in the first. Sometimes China Clay is heated with less sulphuric acid than is necessary to decompose it—about half, or even less, of it is thus affected—and the result is alum cake, in which naturally a lot of the clay retains its original, normal properties. This product, too, is used for paper loading purposes. Besides the commoner alum—the potash one, which is popularly known only as " alum "—there are ammonia alum, soda alum, chrome alum, and iron alum. In these the items named are substituted for potash in the alumina sulphate ; the first two are white, the third is red, and the fourth is pale violet.

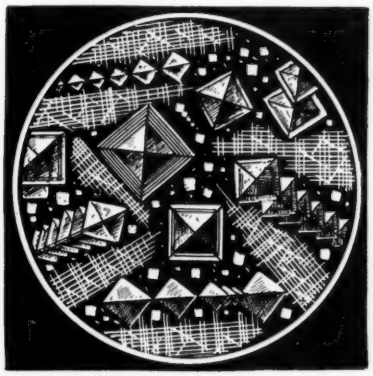
Suspend a clean, well washed, cinder in a very strong, hot solution of alum, and leave the vessel containing it in a cool place for a few days undisturbed, when it will become thickly covered with extremely attractive, fairly large and perfect octahedral crystals of alum. These will be at first transparent, but will gradually become opaque white like porcelain. Alumina, when heated in the oxidizing part of the blowpipe flame, is turned deep blue in colour. When alumina sulphate is kept in a red-hot condition for awhile it is changed, by the disappearance of its sulphuric acid content and simultaneous oxidation, into alumina.



1.—One Twenty-fourth inch of Film of Gelatinous Alumina.



2.—One Twenty-fourth inch of Layer of Granulated Alumina.



3.—One Twenty-fourth inch of Layer of Alum Crystals.

Alumina is a feeble base, yet its salts give an acidic reaction. Seeing that alum and alumina have for a long time been regarded in medical circles as poisonous, and bearing in mind the number of people who are concerned in their preparation, and hence liable to swallow dust containing them, the following quotation from a standard volume written by a famous toxicologist will not be altogether inappropriate. He says:—"Alum baking powders, containing from 30 to 40 per cent. of alum mixed with carbonate of soda, used to be found in commerce, and for a long time many tons were sold yearly. It is not usual at present to meet with an alum baking powder. When water is added to such powders, decomposition takes place, the result being soda sulphate and alumina hydrate, carbonic acid being given off. Were the hydrate, in small doses, capable of producing indigestion, or disease of the central nervous system, it seems astonishing that, considering the enormous number of persons who have used alum baking powders, there should not be some definite evidence of its effect. The senior author and his family for months together once used alum baking powders without any apparent injury; and there is little doubt that alumina hydrate passes out of the system. . . ." Large *single* doses—which must be an ounce or more!—of alum or its salts are, however, dangerous to the human body.

China Clay Uses

We publish below some formulæ in which China Clay enters, in some cases quite largely. We believe that this information, although, of course, known by the users, will still be of interest to readers, as showing how greatly China Clay, China Stone and ball clay enter into the composition of many bodies.

Body Compositions

For Architectural Faience.

(I.) China Clay, 48 parts; China Stone, 10 parts; ground calcined flint, 44 parts; buff burning slender fireclay, 300 parts.

(II.) China Clay, 20 parts; Cornish China Stone, 5 parts; ball clay, 20 parts; fireclay (passed through sieve), 10 parts; ground calcined flint, 8 parts; calcined fireclay, 5 parts.

Faience Engobe or "White Body."

(III.) China Clay, 4 parts; China Stone, 2¼ parts; ball clay, 4 parts; ground flint, 2¼ parts.

(IV.) China Clay, 10 parts; ground China Stone, 2 parts; ground calcined flint, 1 part; whitening, 1 part; ball clay, 2 parts.

(V.) China Clay, 7½ parts; ground China Stone, 4 parts; ball clay, 4½ parts; calcined flint, 1¾ parts; plaster of Paris, 1 part; whitening, 1¼ parts.

White Glazing Tile Bodies

(I.) China Clay, 6 parts; Cornish China Stone, 2½ parts; best dry ball clay, 5 parts; calcined ground flint, 8½ parts.

(II.) Best China Clay, 6 parts; ground Cornish Stone, 2½ parts; finely ground smalt, $\frac{1}{10}$ part; ground calcined flint, 8 parts; blue ball clay, 4 parts.

(III.) China Clay, 50 parts; China Stone, 50 parts; blue ball clay, 50 parts; ground flint, 100 parts.

(IV. Bath Tile Body). Best China Clay, 404 parts; Cornish China Stone, 252 parts; blue ball clay, 430 parts; ground calcined flint, 560 parts.

(V. For Inlay Slips). Best China Clay, 30½ parts; ground Cornish China Stone, 12 parts; blue ball clay, 22 parts; ground calcined flint, 25 parts.

(VI. Common and Barbotine). Strong China Clay, 340 parts; ground calcined flint, 550 parts; blue ball clay, 500 parts.

(VII. Common). China Clay, 84 parts; blue ball clay, 308 parts; ground white earthenware pitchers, 532 parts; calcined flint, 168 parts.

Ivory Tinted Glazing Tile Bodies

(I.) Common China Clay, 5 parts; Cornish China Stone 3 parts; ivory ball clay, 5 parts; ground calcined flint, 8 parts.

(II.) Common China Clay, 4 parts; Cornish China Stone, 2 parts; ivory ball clay, 5 parts; ground calcined flint, 5 parts.

(III. Dark). Common China Clay, 3⅜ parts; Cornish China Stone, 3 parts; ground calcined flint, 7½ parts; dark ivory ball clay, 7¾ parts.

Cream Tinted Glazing Tile Bodies

(I.) Common China Clay, 2 parts; Cornish China Stone, ¾ parts; siliceous Dorset buff ball clay, 5 parts; black Dorse, ball clay, 3 parts; ground calcined flint, 1½ parts.

(II.) Common China Clay, 2 parts; ground Cornish China Stone, 1½ parts; ground calcined flint, 3¼ parts; ivory ball clay, 2 parts; siliceous Dorset buff ball clay, 3 parts.

(III.) China Stone, 4 parts; ivory ball clay, 12 parts; ground silica rock, 12 parts.

Buff Glazing Tile Bodies

(I.) Cornish China Stone, 2 parts; ground calcined flint, 10 parts; ivory ball clay, 16 parts.

(II.) China Stone, ½ part; ground calcined flint, 1 part; black Dorset ball clay, 4 parts; siliceous buff ball clay, 4 parts.

(III.) Ground Cornish Stone, ½ part; superior cane marl, 2 parts; siliceous Dorset yellow clay, 8 parts.

Cane Tinted Glazing Tile Bodies

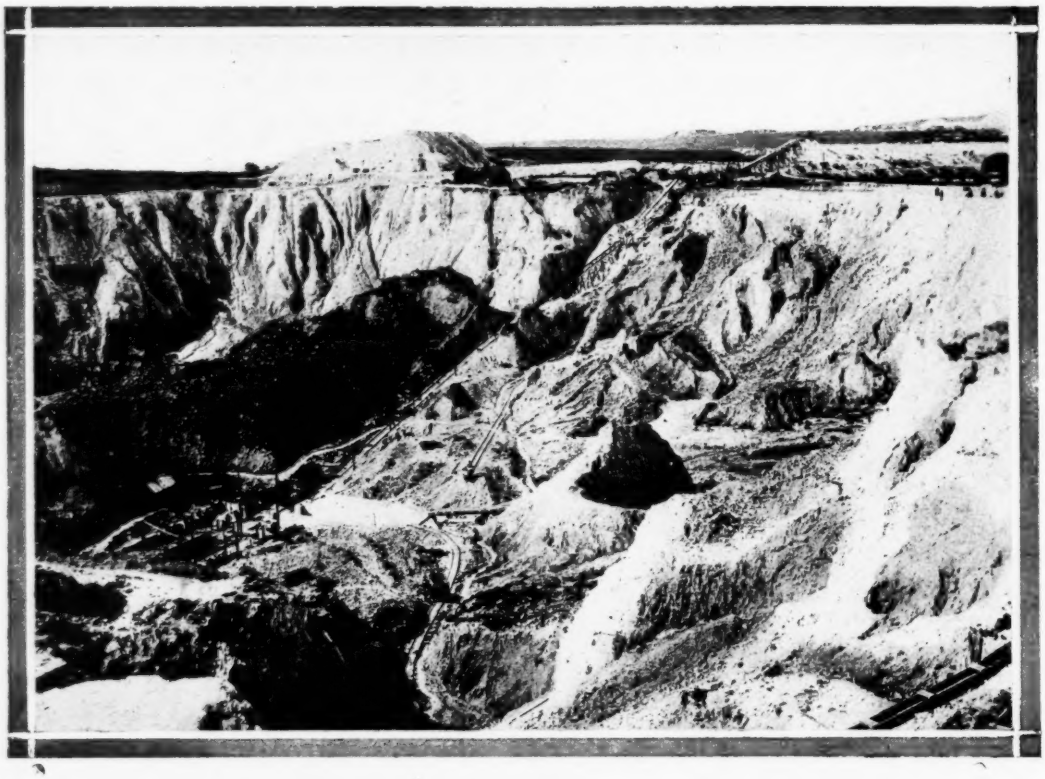
(I.) Cornish China Stone, 1⅛ parts; ground calcined flint, 3¼ parts; superior cane marl, sifted and weathered, 2 parts; black Dorset ball clay, 3 parts.

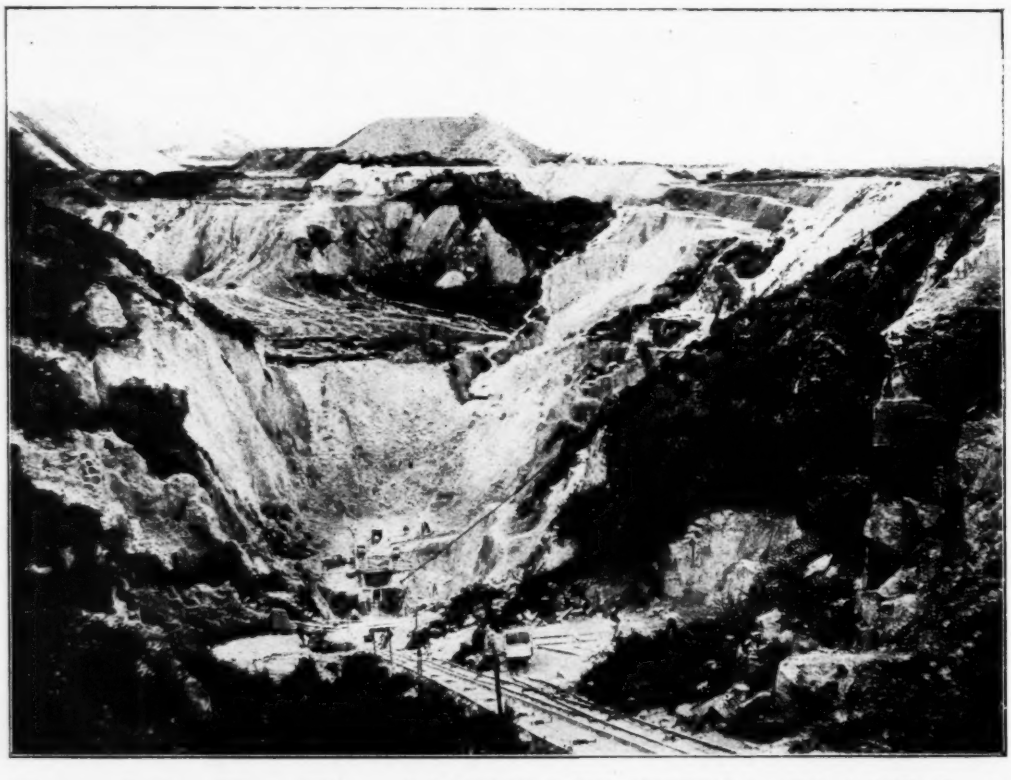
(II.) Cornish China Stone, ½ part; common China Clay, 1¼ parts; ground calcined flint, 2 parts; black Dorset ball clay, 1½ parts; superior cane marl, sifted and weathered, 5 parts.

Salmon Pink Glazing Tile Bodies

(I.) China Clay, 12 parts; Cornish China Stone, 5 parts; calcined Japanese red, 2 parts; ground calcined flint, 12 parts; blue ball clay, 9 parts.

(II.) China Clay, 3 parts; ground white earthenware biscuit pitchers, 19 parts; ground calcined flint, 6 parts; ground calcined Japanese red, 2 parts; blue ball clay, 11 parts.





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China Clay in Tinted Papers

How It Prevents Mottling—Its Ready Association with Aniline Dyes

WITH the continual demand for paper making materials, it is only natural that more and more attention is being directed to the greater use of China Clay, especially in the production of "news" paper, the consumption of which is enormous. Not only is the quantity of China Clay employed in the manufacture of paper being increased because it is a cheapening agent in the cost of production compared with other materials used, but because of its intrinsic value as an easily adaptable material to almost every phase of paper making. From the common tinted papers to the highly finished and heavily faced art papers, the harmless action of China Clay upon other ingredients is being found in practice to be such a valuable characteristic, that its employment bids fair to become increasingly essential for use in paper making. Its remarkable affinity for printers' ink makes its use in "news" a feature of great value, coupled with its adhesive properties which causes it to stick with such tenacity to the fibre of the pulp.

The part China Clay plays in the art of colouring paper is but another instance of its versatility in paper manufacture. In the *Text Book on Pulp and Paper Manufacture*, being prepared under the direction of a joint educational committee representing the industry in Canada and the United States, frequent references are made by Mr. Otto Kress to China Clay in its relation to aniline dyes in his contribution on the colouring of paper.

The Importance of Aniline Dyes

Before the introduction of aniline colours, paper was coloured by means of pigments, dyes derived from either vegetable or animal sources, or colour lakes. These lakes are made from either vegetable or animal dyes, to increase their tinctorial power, resistance to fading, etc. Many of these products were very permanent; but in view of the cheapness, ease of application, and uniformity in strength and shade, the aniline dyes, in so far as American practice is concerned, have with a few minor exceptions replaced both the pigments and natural dyestuffs. During the period of the late war, when a decided shortage of dyestuffs occurred, the paper mills largely reverted to the use of pigments and natural vegetable dyestuffs. The latter appeared on the market in the form of concentrated powders, pastes or lakes, made from osage orange, fustic, quercitron, hypernic, black oak, logwood, etc.

By a lake is understood the colouring matter produced by precipitating a dye as an insoluble or practically insoluble compound upon an inert base, by means of acids, salts, or alkalis, or by means of the base itself. It is of interest to know that such material as aluminium hydrate, certain clays, and green earth have the property of fixing small amounts of basic dyes upon themselves with the formation of lakes.

The important lakes of the basic dyes are compounds of the dye with tannic acid, tartar emetic, etc., formed in the presence of certain bases such as blanc fixe, barytes, whiting, China Clay, green earth or aluminium hydrate.

Lakes of acid dyes are generally compounds of barium, calcium, aluminium, lead, iron or chromium, precipitated by means of the metallic salts, in the presence of the base or simultaneously with the formation of the base. Certain insoluble dyes, such as paranitraniline red, when produced on a base, are sometimes called lakes, but do not properly come under this definition.

Colour lakes made from the vegetable dyestuffs, while important during the recent aniline dye shortage, will not be used in the future, to any extent, as American dyes are now being made in sufficient quantity and quality to satisfy all the needs of the paper industry.

The Use of Pigments

Pigments used in the colouring of paper pulp are of three types; insoluble mineral products, ground either in their natural state, such as ochre, raw umber, etc., or heat treated products, such as burnt turkey umber, etc.; coloured insoluble inorganic compounds, such as Prussian blue, lead chromate, ultramarine, etc., or as insoluble organic compounds which are true aniline dyestuffs such as the vat dyes, which find application in the paper industry by being used as true pigments. These latter dyes will be included under the aniline dyes. On the border line between insoluble pigments and soluble aniline dyestuffs may be considered such products as soluble Prussian blue.

Why Paper Clay should be Gritless

In general, the colouring of paper stock in the beater by means of pigments depends on the mechanical entanglement of the insoluble pigment with the paper stock, there being no direct colouring or absorption of the coloured pigment. The depth of the colouration of the paper, therefore, depends largely on the degree of sizing, the character of the stock (slow stock retaining larger amounts of the pigment than a free stock), character of the pigment, and also on the type and operation of the paper machine. Strong suction, either at the suction box or by the suction roll, tends to produce a two-sided effect on the paper, the top side of the paper being more strongly tinted or coloured than the wire side. With strong suction or with a free stock, there is a tendency to lose a higher percentage of pigment in the back water, the pigment behaving exactly like clay or other loading material. Pigments, if used in large amounts, have a decided weakening action on the paper, acting in this way like ordinary loading materials. Pigments such as the ochres and the other earth colours should be tested for grit, as when used in large amounts, for deep shades, this grit may cause pinholes in the paper, causing frequent breaking of the paper while it is going over the machine; the grit has also a tendency to wear the felts and wires, and to scratch the calender rolls like a gritty clay when used for loading purposes.

Yellow ochres and siennas are natural silicates, the ochres containing hydrated oxide of iron, the siennas containing manganese oxide. The colour varies from yellow to brown, the tinctorial power being very low, while these pigments are of permanent shade, not being affected by size, alum and alkalinity of the water, their action, in so far as the colouring of paper is concerned, is very similar to China Clay. If used in large amounts, in order to produce a deep shade, these products have a decided weakening action on the strength of the finished sheet. Freedom from grit is also important.

Various Prussian blues, both as pigments and in a soluble form, are used quite extensively for the tinting and colouring of paper, these blues being fast to light, but very sensitive to alkali. This is especially important in oatmeal wall paper and hanging papers coloured with these products, as with freshly plastered walls, or with alkaline glues, the colour of the paper may be affected.

Ultramarine and Alum

Ultramarine, a double silicate of sodium and aluminium containing some sodium sulphide, is used quite extensively for the tinting of higher grades of white paper. Ultramarine has the decided drawback of being sensitive to acids and alum, the colour being affected by these agents. The so-called alum resisting ultramarines are superior in this respect to the ordinary ultramarines.

A pigment green made by colouring stock in the beater with chrome yellow and Prussian blue is occasionally used. The green obtained by this mixture is not nearly as satisfactory as that which may be obtained by aniline colours. The tinctorial power of the mixture is low. In so far as the American paper industry is concerned at the present time, the aniline dyes are used almost exclusively for the tinting and dyeing of pulp and paper.

The aniline dyes have the following decided advantages over pigments and natural dyestuffs: (1) Great tinctorial power; (2) ease of application and uniformity of the product, both in shade and strength, so that the dyeing of the pulp or paper is very much simplified; (3) the dyestuffs now available cover every range of colour and shade, and can be chosen according to cost, tinctorial power, resistance to various factors, such as fading, alkali, alum, etc.; (4) the aniline dyes do not decrease the strength of the dyed sheet, as do the pigments.

Aniline dyes, mainly of German manufacture, that satisfied every need of the paper industry were on the market before the war, but, owing to unfortunate difficulties, the paper industry reverted to a considerable extent to the use of pigments and vegetable dyes or lakes prepared from them. Now, however, the American dyestuff industry has so developed that it is possible to secure practically all of the colours available before the war.

Where China Clay Comes In

Basic dyes, such as methyl violet and the blues, safranine, etc., have a tendency to mottle or dye unbleached sulphite more deeply than groundwood, as they have a greater affinity for chemical than for mechanical pulp. In extreme cases this can be overcome by adding the solution of the basic dye in a very diluted condition to the beater furnished with the groundwood stock, and then thickening the furnish by adding the sulphite stock in lap form. In general, a tendency to mottle can be overcome by adding the dye in a very diluted condition. Another means of preventing mottling is to precipitate basic dyes on China Clay which is used for tinting purposes. Many of the basic dyes used for tinting purposes have the property of colouring China Clay, forming a clay dyestuff compound which readily dissociates in the presence of the large volume of water in the beater. By gradually and uniformly colouring the sulphite stock in this way mottling can be prevented in a groundwood-sulphite furnish. A similar difficulty of mottling by basic dyes is sometimes experienced in papers made on the furnish of unbleached and bleached sulphite pulps.

General Notes on Colouring

Paper may be coloured by dyeing the pulp in the beating or by colouring the paper in web form on the calender. As over 95 per cent. of all paper is coloured by dyeing in the beater, calender colouring will be considered as of minor importance and at a later date.

In the operation of manufacturing coloured coated paper, the colour is added directly to the mixture of casein, China Clay, etc., and applied on the coating machine. Considerable colouring is done by means of colour tubs or vats in order to economise in dyestuff for the production of deep shades. The stock is first partly coloured and sized in the beater, and is then put over the paper machine in the usual way, but only partially dried on the first section of the dryers. The paper is then passed through a colour tub and squeeze rolls and finally dried over the balance of the dryers. In this way a deep shade covering just the surface of the paper can be more economically produced than would be the case if the stock was entirely coloured in the beater.

The paper industry does not make use of mordants to combine with the dye so to make a colour lake to increase the fastness of the dyeing, as do the textile, leather and other dye-consuming industries. There are, of course, certain exceptions, such as the eosine, phloxines, rose bengals, and erythrosines, which are usually after-treated in the beater with lead acetate in order to improve their brightness and fastness. Similarly, certain direct blues are decidedly improved, in so far as fastness to light is concerned, by the addition of copper sulphate. There is no question that after-treatment of the dyed stock with the proper mordant would in many cases improve the fastness of the dyeing. This would be especially true if the basic dyes were after-treated in the beater with tannic acid or some cheap extract containing tannin.

Considerable controversy exists as to the proper order of the addition of colour, size and alum to the beater. The author believes that, with very few exceptions, the dyes should be added first and mixed with the pulp, after which the size and then the alum should be added. This appears to be particularly true for the substantive colours, as the precipitated size appears to coat the fibres, making it difficult for the dye to colour them. Comparatively little difference, however, would be made by varying the order of addition with any of the different classes of dyestuffs, except the basic dyes. With basic dyes, in order to prevent any possible precipitation of the free colour base, the author considers it advisable to add the dye after the stock is sized and alumed sufficiently to avoid any danger of alkalinity in the beater. The various dye manufacturers can give the consumer the best directions in regard to the order of addition of colour, size and alum to the beater, and advantage should be taken of their specialised knowledge and experience.

China Clay in Canada

Glowing Account of its Prospects

In the buoyant style characteristic of American and Canadian newspapers, an account has recently appeared in the Toronto *Star* of what is described as an extensive deposit of China Clay in Northern Ontario. Without subscribing to its conclusions or accepting its excessive optimism as to the prospects, we print a digest of the report, so that the home China Clay producers may be aware of the movement on foot to attempt to oust imported clays.

There have been, the account says, up to the present time, two China Clay deposits discovered, staked and tested in Northern Ontario, both of which are on the Mattagami river.

The first of these is a chain in the unsurveyed territory of Mattagami river, east side, five chains from the foot of the Long Portage, in the district of Timiskaming. This deposit is 40 acres in extent and has been tested with a Sullivan drill in various parts all over the whole property. It has been tested to a depth of 75 ft., and even at that depth the bottom has not been reached. The China Clay outcrops in various places, and the overburden varies from nothing to possibly 25 feet on the hill-tops, but the overburden is comparatively slight in comparison with the overburden in the other known deposits of China Clay that are at present marketing their product. A cube of clay from this deposit was brought out by Mr. McCarthy, and it was squared up after it was dried and measured and weighed, and if the deposit were estimated to a depth of 60 ft., although it has been tested to 75 ft., the tonnage in this deposit alone would amount, at a very conservative estimate, to over 35 million tons.

Alleged Tests

No. 2 is another deposit of 40 acres immediately due north of the No. 1. This deposit has an admixture of glass sand, which according to the assays is over 99 per cent. pure, with a very small ferric oxide content of ·176. This makes the glass sand as a by-product a very valuable adjunct to the China Clay. Clay assays and the glass sand assays have been made by L. Joselyn Rogers, B.A., B.Sc., of the University of Toronto. It has also been analysed by Thomas Hayes and Sons, by Pochin and Co., of Salford, England, and the New York Chemical Co., to verify its purity. The silica is large, as is the allumina, and the ferric oxide content is ·13, and on ignition 13·85, which is comparatively light, and compares very favourably with the finest China Clays in this particular.

Varied Uses Claimed

This kaolin is used in the manufacture of white-ware, pottery, floor and wall tile, electrical porcelain, filling and coating of papers, graphite crucibles, glass refractories, paint, linoleum, and other products.

News of the discovery in Northern Ontario quickly reached England, the British Trade Commissioner here being one of the most interesting parties, for data. Mr. Pochin, of Pochin and Co. (the Cornwall China Clay people), has been out here, and made an examination side by side with his finest China Clay.

It is doubtful if the importance of this find is appreciated in Toronto. The industries that now use China Clay and are able to use a clay of not such a fine quality are those that manufacture the vitrified table ware and sanitary ware, hard fire porcelain and linoleum. There are so many uses to which China Clay may advantageously be put that the market is practically unlimited.

U.S.A. Imports of China Clay

In 1919 the amount of China Clay, as certified by the United States Geological Survey, which was imported into the United States amounted to 180,595 short tons, of a value of $1,965,392, and the average price per ton in the country in which they were purchased was $10·88. In 1920 361,800 tons, valued at $3,568,677, were imported into the United States from other countries. These importations in 1920 were 10 per cent. greater than in 1914, which was the year of the largest importation prior to 1920. The importations for 1923 were over 500,000 tons, which shows a marked increase and larger market. The average price per ton in 1920 was $9·86, as compared with $10·88 in 1919. This price, however, which is the price abroad, is only a fraction of the price of foreign clay in New York, where, in 1920, imported kaolin was quoted as high as $25 a ton. The price of China Clay has increased since that time and is now sold in New York at a greater price than that quoted above.

China Clay Notes and News

Industrial Prospects of the West

Our reference last month to the absence from Cornwall and Devon of industries using China Clay as a raw material has called forth some interesting comments. *The Western Morning News* in its London Letter refers to it in this wise :—

A question which may become prophetic is suggested in *The China Clay Trade Review* this month. A writer, who has evidently been thinking pretty hard, asks why cotton is manufactured in Lancashire and pottery in North Staffordshire. Lancashire imports its raw material from abroad and takes its China Clay for filling from Cornwall and Devon. Lancashire is suited to cotton manufacture because of the humidity of its atmosphere. In this respect it is comparable to Cornwall. Staffordshire has no clay except of the coarsest kind. The potteries grew up around it, but it is from the clay of Devon and Cornwall that the beautiful china ware is made.

Why, he asks, are there no cotton mills and no potteries in the West country ? He knows the answer. It is because Lancashire and Staffordshire are near the coal-fields. It is cheaper to carry raw material in limited quantities to the places where they are not than to convey huge trainloads of coal needed to keep the potteries going in the West, something like 300 miles away from the coal-fields. It is this economic hard fact, as everybody knows, which has stood in the way of the industrial development of the West.

White Power the Touchstone

The raising of the question as to why industries which use China Clay to a large extent, such as potteries, cotton mills, and paper mills, have not established themselves in Cornwall where the China Clay is produced, has once again emphasised the fact that our great drawback is cheap power. However, we have the very great advantage which inland industrial areas have not, and that is an extensive sea-board which is, at any rate, as near to the American and Canadian ports as the ports at Lancashire, and a good deal nearer to European ports, which is a factor worth considering when comparing the advantages of one part of the country with another for industrial purposes.

Now that we may be said to be entering upon the electrical era, and the use of electricity is being recognised as a cheaper means of power than coal, there is every reason why Cornwall in the near future should become the centre of those industries in which China Clay is one of the essential raw materials. With adequate water supplies and with ports so easily accessible to pulp exporting countries, it is somewhat surprising that no paper mills have so far been established in the county. The transmission of electricity from a central power station in the county to supply the industrial needs of the China Clay and tin mines, and to provide power needed for such China Clay-using industries as have been mentioned, would give a tremendous impetus to the industrial development of Cornwall, and is a possibility which all interested in the prosperity of the West country should encourage by every possible means. There is no county which offers such prospects for the use of electricity for industrial purposes as Cornwall. Having a humid atmosphere, it is peculiarly suited from a climatic point of view to cotton manufacture, which, curiously enough, is one of the reasons why Lancashire has become the world's centre of the cotton-spinning industry.

Clayopolis Station Improvements

The G.W.R. is engaged in improving St. Austell Station. Alterations and additions include a covered way for vehicles, a foot bridge, enlarged parcels office, new booking office and waiting rooms and extensions of platform. The estimated cost is £2,500.

Fowey Ex-Mayor's Tragic Death

The China Clay port of Fowey was much distressed last month by the tragic death of Mr. Henry Paull, an ex-Mayor and ex-Alderman of the borough, who took his life by exploding an electric detonator in his mouth. Mr. Paull was a well-known figure in Fowey, and was known to shippers using the port in his capacity as manager of the Fowey Tug and Salvage Co. and a director of the marine engineering firm of Paulls, Ltd. At the inquest, health and business worries were ascribed to account for this rash act. He left letters, the following extracts from which were read by the Coroner : " I am finished. Forgive me for what I am doing. You will be better without me." To his son and daughter-in-law he wrote : " Try and forgive, but I am done. My brain is gone. You will feel so broken without me."

Mr. Paull, who was 63, was one of the committee associated with the restoration of Fowey Charter of Incorporation in 1913. A largely attended representative funeral testified to the remembrance by his associates of the work he had done for the borough in happier days.

China Clay Inventor in Trouble

William Hobson, formerly employed in the Staffordshire potteries, and for the last two or three years residing in the St. Austell China Clay district for the purpose of exploiting his invention for the drying of China Clay by a new process, got himself into trouble last month, as a result of which he was sent to prison by the magistrates for a month's hard labour. Mr. J. W. Higman, a prominent China Clay merchant, was the chairman of the Bench.

Hobson was charged with obtaining food from Mrs. Jane Smith, of St. Austell, to the value of 16s. and from Mrs. Dorothy Harris, of St. Austell, to the value of 13s. Mrs. Jane Smith stated that Hobson called at her house and asked for lodgings on Wednesday, October 22. He represented himself to be an employee of the Felspar Mines at Roche, and that he had been sent by the Captain to St. Austell to do some engineering work. He asked to be taken in for a few days and agreed to pay at the rate of 22s. per week. He remained till the following Sunday and left without paying. Frederick Guy Retallick, Captain of the Felspar Mines, Roche, stated prisoner commenced work at the mines on September 23 cleaning felspar, and left on October 10. As far as he knew his job was still open to him. The statement that he had been sent to St. Austell to do some engineering work was not true. In reply to Hobson, he did not know on what terms he had been engaged by Mr. Varcoe, the manager, but he was paid 3s. 6d. per day.

Hobson pleaded not guilty, and said that Mrs. Smith was altogether wrong. He was the proud possessor of an invention for drying China Clay, and had sold a share of that invention to certain parties and he wanted to get his invention to work. A job at the Felspar Mines was given him practically out of charity. He came to St. Austell for the purpose of selling an option. It would cost £1,000 to put up a dry, and in explaining these things to one of the lodgers Mrs. Smith had misunderstood things. There was no attempt to secure anything by false pretences. He had the right of a refund of £10 from a firm, and Mrs. Smith would have been paid. He had come to St. Austell to get this matter adjusted when he was approached by the police.

Dorothy Harris said, on October 27, on the strength of Hobson's statement that he was working on his own invention at Rosemellyn Clay Works, Bugle, she took him to lodge at 23s. per week. He left later owing her 13s.

P.C. Osborne said he had examined the pay-roll of the Rosemellyn China Clay Works and found that prisoner had never been employed there.

Hobson said Mrs. Harris had mixed things up. He had not told her he was working at Rosemellyn Clay Works—in fact he had never been there. He was the owner of an invention, No. 217774, and told Mrs. Harris he had two or three parties interested, one of whom was directly or indirectly connected with Rosemellyn, and if the thing went through probably his invention would be put in at Rosemellyn. He submitted that there had been no false statements or that there had been any attempt to defraud. Hobson was sentenced to one month in each case, the sentences to run concurrently.

St. Austell Lady's Will

Miss Roxana Stocker, of Glenview, St. Austell, whose father was one of the pioneers of the China Clay industry, left £35,123, of which £34,462 is net personalty. Probate has been granted to her nephews, Mr. T. Medland Stocker, of Trelawney, St. Austell, and Mr. Henry Stocker, of Boughmead, St. Austell. Testatrix left one-fourth of her estate to the children of her late brother, Francis Edward Stocker, or their issue ; one-fourth to the children of her late brother Thomas Stocker, or their issue ; one-fourth to the children of her late brother, Edward Stocker, or their issue ; and one-fourth to her sister, Sophia Weekes, or her issue.

How Clay Magnates are Made

At a luncheon in connection with the opening of the new Sunday school in the China Clay village of Trewoon, the Rev. J. Johns, the St. Austell Circuit Wesleyan superintendent minister, referred to the close association of Trewoon with the China Clay industry and its merchant princes, and remarked, amid laughter and jocular dissent, that all they had to do was to dig a pit, use a spray on the clay, build a dry, and nature did the rest. Mr. James Perry, a prominent China Clay merchant, speaking later at the same luncheon, alluded to Mr. Johns' remark, and said he knew of one or two clay-pits at the present time in connection with which drys were already erected, and he was prepared to put Rev. Johns on to them and give him a chance to make his fortune.

China Clay Cases in County Court

Before His Honour Judge Gurdon, at St. Austell, on November 15, Mr. V. A. Thrall (Messrs. Coulter, Hancock and Thrall, Truro) made an application for the payment out in a lump sum of £57 to settle accounts and a weekly payment towards the maintenance of the widow and dependant of the late Mr. Andrew Stephens, who was killed at Gunheath China Clay Works, in respect of which the sum of £330 had been paid into court. Mr. Thrall said he understood that there were unsettled accounts, but he found these had been paid by the widow, thus depleting her savings entirely. He asked His Honour if he could reimburse the widow for the amount spent, but His Honour said he could not do that, but the money was there if it should be required. The money would not last long, and he decided to make an order for the weekly payment of 30s. per week for six months, and that £200 should be invested in 5 per cent. War Loan.

Jabez Brokenshire, clay labourer, of Sandy Bottom, St. Austell, made an application under the Bankruptcy Act before His Honour Judge Gurdon at the same Court, for the Court to administer his estate. His liabilities were under £50 and he offered to pay 1s. in the £, but could not manage to pay forthwith. An order was made for the payment of 8s. every twenty-eight days.

New Pottery J.P.'s

New magistrates appointed recently for the Borough of Stoke-on-Trent include: Mr. William Rhodes, managing director of Keeling and Co., Ltd., Dalehall Works, Burslem; Mr. J. T. Webster, chairman of Twyfords, Ltd., Hanley, and vice-chairman of the British Pottery Manufacturers' Federation; Mr. H. Arrowsmith, of T. Arrowsmith and Sons, Ltd., stilt and spur manufacturers, Burslem; Mr. Arthur Hollins, financial secretary to the National Pottery Workers' Society, and ex-chairman of the National Council of the Pottery Industry; Mr. William Tunnicliffe, who is an organiser in the china section of the trade for the Pottery Workers' Society; Mr. W. Callear, one of the organisers of the National Pottery Workers' Society; Mr. W. J. Brown, of Samuel Ford and Co. (Burslem), Ltd., pottery manufacturers; and Mr. A. C. Harrison, a director of Harrison and Son (Hanley), Ltd., manufacturers of potters' colours.

How Wembley Benefited Potters and Clay Producers

Mr. John Rushton, of the committee of the exhibitors at the British Empire Exhibition, in a letter to the Press has disclosed the fact that Staffordshire charities have benefited to the extent of £1,075 as a result of the successful efforts made by Mr. Harold T. Robinson, managing director of the Cauldon Potteries, Ltd., in inducing Messrs. J. Lyons and Co., Ltd., the caterers, to use only British-made pottery in the catering establishments.

It was argued that a great British Exhibition should use only British-made pottery, but Messrs. Lyons pointed out that the cost of British ware would be higher than had been quoted by the Limoges manufacturers. The British manufacturers pressed their point, and ultimately Messrs. Lyons agreed that only British ware should be used in the catering throughout the Exhibition. In the case of the Lucullus Restaurant, however, Messrs. Lyons stipulated for the highest class of English ware. The order was mainly executed by Cauldon Potteries, Ltd. The difference in the cost between the English and French china worked out at about £1,075, and a compromise was effected whereby the British manufacturers agreed that if Messrs. Lyons would use only English ware they would give away the whole of the profit on the Lucullus china to local charities. Mr. Robinson has generously borne the whole of the donation. The action he, at the instance of the British Pottery Manufacturers, took, in the early part of the year, to safeguard the interests of the potteries has resulted incidentally in a sum of not less than £3,000 being paid out in wages to the local workers, and a further sum to the producers of potters' materials, which they would not have had if the foreign china had been used at Wembley.

China Clay Merchant Widowed

The China Clay district of St. Austell was much surprised to learn of the sudden death of Mrs. Dyer, wife of Mr. S. J. Dyer, a well-known St. Austell China Clay merchant, on December 3, at the age of 51. Mrs. Dyer had suffered from an affection of the heart for some time, but had lately been much improved in health and attended the Wesleyan Bazaar at St. Austell the previous week. On the day of her death she was preparing tea when she had a sudden attack and died at 10.30 the same day. Much sympathy has been expressed with Mr. Dyer and his two sons and two daughters in their sudden bereavement. Mrs. Dyer was, like her husband, a devout member of the Wesleyan Church. She was of a kindly and benevolent disposition, and was responsible for many philanthropic acts which endeared her to all who had associations with her. At the funeral, which was attended by hundreds of sympathisers, there were many manifestations of the respect and esteem in which she was held.

The funeral, which was the largest witnessed at St. Austell for a long time, took place at St. Austell Cemetery on December 6, in beautiful weather. The hearse, seven mourning coaches and the assembled sympathisers filled King's Avenue, and when the procession moved off from "Claybourne," Capt. Dyer's residence, many people stood on the footways to watch the cortege pass. Fifty wreaths were sent, and as it was impossible to make provision for all of these in the hearse, many of them were carried by the processionalists. Such a beautiful array of floral emblems has seldom been seen at a funeral at St. Austell.

The family mourners were: Capt. S. J. Dyer (husband); Messrs. Percy and Leslie Dyer (sons); Arthur Venner (brother); T. Leigh (son-in-law); J. M. Best (brother-in-law); A. and J. Pellymounter (cousins); Wilson and Fred Dyer (brothers-in-law); W. Harvey and J. Wilkinson (cousins); Arnold, John, Wesley and Russell Dyer (nephews); Capt. J. Gilbert (brother-in-law); Wilson and Jos. Gilbert (nephews); Fred Tippett (nephew); S. Dyer (Truro); Capt. T. Dyer; P. Samson; A. Tretheway; Rev. T. D. Corlett; F. Leigh; W. H. Jane; S. H. Hanham (Plymouth).

In addition to trading, religious, and public communities of St. Anstell being largely represented, the China Clay industry, especially the works in which Capt. Dyer is interested, were represented by Directors, Captains and workers from Great Treviscoe, Central Treviscoe, Hallivet, Rosevear, Imperial Goonbarrow, Trethowel and Burthy. They included Messrs. James Perry, S. and A. Perry (Burthy China Clay Co.), H. S. Andrew (English China Clays, Ltd.), B. C. Andrew (Rosevear China Clays, Ltd.), Hart Nicholls (North Goonbarrow China Clay Co., Ltd.), John Hooper (Anchor United China Clay Syndicate, Ltd.), J. Pascoe (New Halwyn China Clay Co., Ltd.), Jas. Venning (Rosevear China Clays, Ltd.), J. W. Higman (Chairman China Clay Joint Industrial Council), G. B. Dobell (Secretary China Clay Employers' Federation), S. Benson (Secretary China Clay Joint Industrial Council), W. Mutton, F. W. Mutton, J. Morton, H. D. Kenyon; Capts. S. Pascoe, C. Thomas, J. Pedlar and A. Tonkin, the last named representing Great Treverbyn China Clay Co., Ltd.; Messrs. F. W. Jenkin (Chairman St. Austell Rural Council), T. H. Williams (Chairman Urban District Council), E. H. Richards, T. Jane, W. H. Bettison, T. H. Treleaven, G. W. Treleaven (Heneward China Clay Co., Ltd.), W. Phillips, W. Wedlake (South Carclaze Clay Co.), Jos. Richards, T. H. Couch, J. H. Knight, J. Dingle, E. T. Hamilton, A. Horne, D. Warne, T. Hewett, S. P. Bunn, W. W. R. Nicholls.

In addition to the family and individual floral emblems were the following representative ones: Messrs. E. S. Hext and C. E. Hewett (Trustees Lamb Estate); Directors Rosevear Clays, Ltd.; Director Imperial Goonbarrow Clays, Ltd.; Trethowel China Clay Co.; Directors Hallivet China Clay Co., Ltd.; Great Treviscoe Clays, Ltd.; North Goonbarrow Clay Co.; Burthy China Clay Co; workmen at Rosevear China Clay Works; Great Treviscoe employees; Imperial Goonbarrow employees.

China Clay Producers on Trade Prospects

Mr. Walter Sessions, one of the managing directors of English China Clays, Ltd., says: "The break in prices has probably reached low-water mark, and such prices can only show considerable losses to producers. In 1925 prices will probably harden, and before the end of the year there should be considerable rises. English China Clays, Ltd., is very busy on development work, and are producing and shipping in very largely increased quantities. At Stannon Moor Clay Works, many miles of double nine-inch pipe are being laid, and filter presses are being established at the Wenford dries. These improvements, it is expected, will produce increased quantities of clay in a given period, and at the same time will lower the cost of production."

After referring to the upset in prices following the break-up of the Producers' Association, Mr. John Lovering, of the firm of John Lovering and Co., Ltd., is of opinion that by Christmas the trade generally will be more stabilised, and the demand in all markets will enable producers to resume prices nearer those operating under the Association. The producers of the very best grades have no necessity to enter into indiscriminate price-cutting competition, as the demand for these clays is such as to obviate this.

China Clay Merchant's Will

Mr. William Marshall Grose Stocker, of Maxwelton, Basford, Stoke-on-Trent, Staffs., a director of China Clay companies and a partner in the firm of Messrs. Grose and Stocker, of Stoke-on-Trent, with extensive clay works in Cornwall, who was killed as the result of an accident at Treskilling Clay Works, Luxulyan, near St. Austell, on September 2nd, aged 48 years, left estate of the gross value of £13,340, with net personalty of £11,713.

Mr. G. T. Petherick's Sister's Fortune

The will of Mrs. Margaret Barratt, of Holywath, Coniston, Lancs., daughter of the late Mr. George Petherick, St. Austell, has been proved at £146,682, with net personalty £146,321. Probate has been granted to her daughter, Mrs. Emily Hext, Buckerell Lodge, Exeter; her brother, Mr. George Tallack Petherick, Porthpean House, St. Austell, and Mr. Henry Bordley Greenwood, solicitor, Kendal, Westmorland. There are many charitable and domestic bequests. Mr. G. T. Petherick is financially interested in English China Clays, Ltd.

China Clay Jettyman's Compensation

At St. Austell County Court on December 9, his Honour Judge Gurdon dealt with the payment into Court by the G.W.R. of the sum of £394 16s. compensation in respect of the death of William Henry Patterson, of Church Street, Fowey, who was fatally injured while employed at Fowey China Clay loading jetties on October 8, when his arm was wrenched off by a crane, as a result of which he died in Fowey Cottage Hospital. The widow applied for the payment out of £25 to meet certain expenses, and £2 per week for herself and children.

The widow was now receiving 6s. per week from the N.U.R. Orphan Fund in respect of the two younger daughters.

His Honour acceded to the widow's request for the payment out of a lump sum of £25, and £2 per week until further order, £200 to be invested in War Loan and the balance placed in the Post Office.

American and British China Clay

According to an American contemporary, producers of clay in the United States are apprehensive of greatly increased imports as a result of the dissolution of the association of producers in Great Britain. The American Tariff Commission is making a survey of the situation, and it is probable that legislation will be offered at the forthcoming session of Congress proposing higher rates of duty on both crude and China Clays. The existing law carries a duty of $2.50 per ton on kaolin and $1 per ton on unwrought or unmanufactured clays.

Wanted, Ball and China Clay

A firm of selling agents and importers in San Francisco wish to communicate with British producers of ball and China Clay, with a view to obtaining agencies, on a commission basis, for the State of California. They request that samples and an analysis of the clay should be sent with quotations. (Reference No. 496, *Board of Trade Journal.*)

Surveying and Levelling

By "C. C. C."

In China Clay mining, as in tin mining, a considerable amount of surveying and levelling has to be done. At the first onset in laying out a mine and producing plant, shafts, levels, engine-houses, incline roads, tram-lines, pipe lines, micas, pits, tanks, dries, railway sidings, storm drains, washing-pools, the best places for refuse dumps (*i.e.*, sand, burden and waste mica), all these things have to be dealt with, and most of them come up again at intervals for consideration and adjustment as the mines extend and develop, so it is necessary or those in charge to have a practical knowledge of at least the elementary stages of surveying and levelling. Managers of clay-mines have to be versatile men. They have problems appertaining to manual labour, the purchasing of materials, pumping and hauling plants, micas for conditioning clays, filterpress and dries to dry it so that only the exact percentage of constitutional water shall remain, laboratory work—sample testing for grading and pricing, milling and mixing for ground and colloidal clays, and not least the theory and practice of the theodolite so as to use it in laying out all or any of the tasks mentioned at the beginning.

A speaker at a recent public function said, "Clay fortunes were easily made," all one had to do was to—"uncover the clay and turn on the spray." Evidently he was a stranger to the clay district; let him have 12 months as manager during development period with a flood or two thrown in, and I think he would alter his tale.

Use of the Theodolite

In surveying or levelling the theodolite is the instrument used for any big undertaking, and in the hands of a practical man renders most jobs fairly simple. Of course in driving to meet in long tunnels or levelling over very uneven ground, care has to be taken to be accurate, but generally speaking it can be done without having recourse to intricate trigonometrical calculations.

I have seen the anglemeter used to obtain the approximate height of a dry-stack, a 7 ft. rule with level inset and degrees marked on it could be used similarly, or even a walking stick on a sunny day by proportioning the stick and stack with their shadows. I should think the "dumpy level" as used by the Royal Engineers would be worth introducing in the clay area as being admirably adapted to the class of work, especially levelling. Surveying, of course, in Cornwall and Devon is rendered fairly easy by the excellent ordnance maps obtainable. With tracing paper, proportional compass or a pentagraph enlarged drawings can be made from tracings of special areas. The usual procedure in ordinary levelling, for tram-lines, light railways or pipe-lines, is, after the main points or bench-marks are taken and pegged out with the theodolite, the intermediate points, or the grade from one to the other, is found by boning-rods, ordinary sighting level or level and staff. In underground mining before the theodolite came into general use, the direction of a level or tunnel driven out from a shaft was found by "hanging lines." A couple of plumb-bobs attached to lines were let down the shaft, the bobs immersed in pails of water at the bottom to steady them (rather a difficult job in deep wet shafts), then the lines were "sighted" dead in line with the object at brace of shaft, and down below two others were hung in the level in an exact alignment with those in the shaft. The lines in the shaft were then taken away, but those in the tunnel were kept twisted up around the nails, while the tunnel was being driven forward, and each time a sett was put in, the lines were dropped down and a lighted candle held in the end, in line with the hanging lines, the sett centred on it, then the lines wound up around the nails until the next sett wanted fixing, and so on until the level "holed through."

This is a very simple and effective method if started right and carefully followed, but when through late sighting or carelessness the end of level got out of focus, with the old method alone some very crooked levels were driven. Now with a Gunter's chain and the compass on the theodolite it can easily be rectified.

Shipping and Export News of the Month

We give below the latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—November, 1924

Arrival Date.	Name.	Sailed.	Destination.
Nov. 1,	S.S. *Cervantes*	Nov. 6,	Genoa
Nov. 2,	S.S. *Mersey*	Nov. 5,	Ridham
Nov. 3,	*Amanda*	*	
Nov. 3,	S.S. *Avanville*	Nov. 6,	Preston
Nov. 3,	S.S. *James Tennant*	Nov. 5,	Bristol
Nov. 3,	M.V. *Anna*	Nov. 6,	Harburg
Nov. 4,	M.S. *Tartar*	Nov. 7,	Antwerp
Nov. 4,	S.S. *Tryggve*	Nov. 6,	Gothenborg
Nov. 5,	S.S. *Brier Rose*	Nov. 6,	Ridham
Nov. 5,	S.S. *Cromwell*	Nov. 8,	Preston
Nov. 5,	S.S. *Blush Rose*	Nov. 8,	Ridham
Nov. 5,	S.S. *Coral*	Nov. 8,	Weston Point
Nov. 5,	S.S. *Mellanear*	Nov. 10,	Terneuzen
Nov. 6,	S.S. *Horsham*	Nov. 8,	Antwerp
Nov. 6,	*Jane Slade*	*	
Nov. 6,	S.S. *Hartford*	Nov. 8,	Preston
Nov. 6,	*Alice Williams*	Nov. 12,	Runcorn
Nov. 6,	S.S. *Pylades*	Nov. 8,	Methil
Nov. 7,	S.S. *T. P. Tilling*	Nov. 10,	Charlestown
Nov. 7,	S.S. *Fairland*	Nov. 11,	Liverpool
Nov. 7,	*Clytia*	Nov. 10,	Charlestown
Nov. 7,	S.S. *Kaspar*	Nov. 11,	Harburg
Nov. 7,	S.S. *Spaarnestroom*	Nov. 11,	Amsterdam
Nov. 7,	S.S. *Aurora*	Nov. 11,	Leith
Nov. 8,	S.S. *Pickmere*	Nov. 10,	Runcorn
Nov. 8,	S.S. *Industria*	Nov. 13,	Pasages
Nov. 8,	*Naiad*	Nov. 15,	Par
Nov. 9,	S.S. *Chenonlin*	Nov. 13,	Genoa
Nov. 9	S.S. *Marta*	Nov. 10,	Par
Nov. 10,	S.S. *Guardian*	Nov. 11,	Charlestown
Nov. 10,	S.S. *Ewy*	Nov. 12,	Vargow
Nov. 10,	*Uranus*	Nov. 20,	Danzig
Nov. 10,	M.V. *Start*	Nov. 19,	Gefle
Nov. 10,	S.S. *Robrix*	Nov. 11,	Charlestown
Nov. 11,	S.S. *Ebba*	Nov. 14,	Genoa
Nov. 11,	S.S. *Shellie*	Nov. 14,	Fleetwood
Nov. 11,	S.S. *Vilvorde Maritime*	Nov. 13,	Brussels
Nov. 11,	*M. A. James*	Nov. 19,	Runcorn
Nov. 11,	M.V. *Voorwaarts*	Nov. 22,	Raamsdonksveer
Nov. 11,	S.S. *Falmouth Castle*	Nov. 13,	Runcorn
Nov. 11,	S.S. *Reedness*	Nov. 15,	Terneuzen
Nov. 12,	S.S. *Baron Sempill*	Nov. 19,	Boston, Mass.
Nov. 12,	M.V. *Willyvonne*	Nov. 19,	Rouen
Nov. 13,	S.S. *Philotis*	Nov. 14,	Hamburg
Nov. 13,	S.S. *Kilmarnock*	Nov. 17,	Barrow-in-Furness
Nov. 13,	S.S. *Dorrien Rose*	Nov. 15,	Rouen
Nov. 13,	*Pursuit*	Dec. 3,	Newcastle
Nov. 13,	*Alma*	Nov. 28,	Dundee
Nov. 14,	S.S. *Baron Wemyss*	Nov. 20,	Portland, Me.
Nov. 14,	S.S. *Clara Monks*	Nov. 19,	Preston
Nov. 14,	*Mary Barrow*	Dec. 2,	Par
Nov. 15,	S.S. *Marta*	Nov. 20,	Wargoen
Nov. 15,	S.S. *Bruxelles Maritime*	Nov. 20,	Brussels
Nov. 15,	S.S. *Ferndene*	Nov. 22,	Antwerp
Nov. 15,	M.V. *Hamme*	*	
Nov. 16,	M.S. *Elmworth*	Nov. 22,	San Francisco
Nov. 16,	S.S. *Hesleyside*	Nov. 27,	Philadelphia
Nov. 16,	S.S. *Shoreham*	Nov. 20,	Preston
Nov. 16,	S.S. *Charlus*	Nov. 20,	Grimsby
Nov. 16,	*Erika*	Dec. 2,	Munkedal
Nov. 16,	S.S. *Towy*	Nov. 20,	Penarth
Nov. 17,	*James Postlethwaite*	Dec. 2,	Mersey
Nov. 17,	*Concordia*	*	
Nov. 17,	S.S. *Magrix*	Nov. 20,	Rochester
Nov. 17,	*Ryelands*	*	
Nov. 17,	S.S. *Lochaber*	Nov. 20,	Liverpool
Nov. 17,	S.S. *Cornish Trader*	Nov. 22,	Rotterdam
Nov. 18,	S.S. *Marena*	Nov. 22,	Weston Point
Nov. 18,	*Mary Ann*	Dec. 3,	Weston Point
Nov. 18,	S.S. *Beeston*	Nov. 22,	Aberdeen
Nov. 19,	S.S. *Mellanear*	Nov. 26,	Antwerp
Nov. 19,	S.S. *Farfield*	Nov. 25,	Ridham
Nov. 19,	*Elisabeth*	Dec. 3,	Munkedal
Nov. 19,	M.V. *Dronning Dagmar*	Nov. 28,	Odense
Nov. 21,	S.S. *Ulooloo*	Dec. 2,	Newport News
Nov. 21,	S.S. *Adra*	*	
Nov. 21,	S.S. *Blush Rose*	Nov. 26,	Rouen
Nov. 21,	S.S. *Ribbledale*	Nov. 25,	Preston
Nov. 21,	*Trio*	Dec. 2,	Harburg
Nov. 21,	S.S. *Essonite*	Nov. 29,	Rouen
Nov. 21,	S.S. *Falmouth Castle*	Nov. 27,	Weston Point
Nov. 21,	S.S. *Bangor*	Nov. 27,	Weston Point
Nov. 21,	S.S. *Mondara*	Nov. 26,	Preston
Nov. 22,	*Adelaide*	*	
Nov. 23,	S.S. *Ebbrix*	Nov. 28,	Ridham
Nov. 26,	S.S. *Arclight*	Nov. 30,	Bo'ness
Nov. 26,	S.S. *Westdale*	Nov. 27,	Par
Nov. 26,	M.V. *Albert Mou*	Dec. 2,	Gothenburg
Nov. 26,	S.S. *Sutton*	Nov. 29,	Liverpool
Nov. 26,	S.S. *Amstelstroom*	*	
Nov. 27,	S.S. *Brier Rose*	Nov. 30,	Manchester
Nov. 27,	S.S. *Pylades*	Dec. 3,	Leith
Nov. 28,	S.S. *Ratapiko*	Dec. 3,	Gravesend
Nov. 28,	*Australia*	*	
Nov. 28,	M.V. *Rosetta*	Dec. 3,	Swansea
Nov. 28,	*Louise Ernest*	Dec. 3,	Pentewan
Nov. 29,	S.S. *Polly*	*	
Nov. 29,	M.V. *Hunte*	Dec. 3,	Fisherow

* Signifies " In port."

Par Harbour Shipping—November, 1924

Arrivals

Date.	Vessel.	From.
November 1,	S.S. *Tosca*	Rochester
November 1,	S.S. *T. W. Stewart*	Kingsbridge
November 4,	S.S. *Treleigh*	Portreath
November 4,	S.V. *Pet*	Falmouth
November 4,	S.V. *Duchess*	Mevagissey
November 10,	S.S. *Marta*	Khristinehamn
November 11,	S.V. *Naiad*	Fowey
November 11,	S.V. *Oroak*	Penryn
November 12,	S.V. *Triumph*	Port Houstock
November 12,	M.V. *Earl Cairns*	Port Talbot
November 12,	S.S. *Freighter*	Exmouth
November 13,	S.S. *St. Enoch*	Penzance
November 13,	S.V. *Englishman*	Penzance
November 14,	S.S. *Lochabar*	Barry
November 14,	S.S. *Magrix*	Hull
November 14,	S.V. *J.N.R.*	Port Houstock
November 14,	S.V. *Henrietta* (1)	Port Houstock
November 16,	S.V. *Henrietta* (2)	London
November 16,	S.V. *Rothersands*	Mevagissey
November 18,	S.V. *Regina*	Torquay
November 21,	M.V. *Antigoon*	Youghal
November 21,	S.V. *Flying Foam*	Megavissey
November 22,	S.S. *Guardian*	Plymouth
November 23,	S.S. *Treleigh*	Cardiff
November 23,	S.S. *Orleigh*	Penzance
November 23,	S.V. *Ivy*	Port Houstock
November 27,	S.S. *Westdale*	Berwick

Sailings

Date.	Vessel.	Destination.
November 1,	S.S. *Palmerston*	Ternezeun
November 3,	S.V. *Amanda*	Fowey
November 4,	S.S. *T. W. Stewart*	Gravesend
November 6,	S.V. *Hosianna*	London
November 6,	S.S. *Tosca*	Charlestown
November 8,	S.S. *Treleigh*	Runcorn
November 11,	S.V. *John Sims*	Weston Point
November 11,	M.V. *Hetty*	Barry
November 11,	S.V. *Albert*	Gotenborg
November 12,	S.V. *Lady Agnes*	London
November 12,	S.V. *Fanny Crossfield*	Leith
November 12,	S.V. *Pet*	London
November 12,	S.V. *Duchess*	Weston Point
November 13,	S.V. *Oroak*	Gravelinnes
November 14,	S.S. *St. Enoch*	Garston
November 15,	S.S. *Freighter*	London
November 16,	S.V. *Naiad*	Antwerp
November 17,	S.S. *Lochabar*	Fowey
November 17,	S.S. *Magrix*	Fowey
November 20,	S.V. *Triumph*	Plymouth
November 20,	S.V. *J.N.R.*	Pentewan
November 27,	S.V. *Henrietta*	Queenborough
November 27,	S.V. *Rothersands*	Runcorn
November 27,	M.V. *Antigoon*	Antwerp
November 27,	S.S. *Guardian*	Rochester
November 27,	S.S. *Treleigh*	Runcorn
November 27,	S.S. *Orleigh*	Grimsby
November 28,	M.V. *Earl Cairns*	Gloucester

Charlestown Shipping—November, 1924

Arrivals

Date.	Vessel.	From.
October 27	*Leif*	Reval
November 3	*C. F. Nurse*	Falmouth
November 6	*Tosca*	Par
November 9	*Trio*	Frangsund
November 10	*T. P. Tilling*	Fowey
November 10	*Guardian*	Plymouth
November 10	*Robrix*	Plymouth
November 11	*Clytia*	Fowey
November 12	*S. F. Pearce*	Torquay
November 13	*Lady Daphne*	Torquay
November 14	*Scone*	Torquay
November 19	*Mary Miller*	Falmouth
November 22	*Venturer*	Truro
November 22	*Bulla*	Falmouth

Sailings

Date.	Vessel.	Destination.
November 4	*C. F. Nurse*	London
November 10	*T. P. Tilling*	Larne
November 11	*Leif*	Leith
November 11	*Tosca*	London
November 12	*Guardian*	London
November 12	*Robrix*	London
November 16	*Clytia*	Granton
November 17	*S. F. Pearce*	Rochester
November 18	*Lady Daphne*	Rochester
November 18	*Scone*	Rochester
November 19	*Mary Miller*	Runcorn
November 25	*Venturer*	London
November 30	*Bulla*	London

China Clay Exports

RETURN showing the exports of China Clay, including Cornish or china stone, the produce or manufacture of the United Kingdom from the United Kingdom to each country of destination, registered during the month ended November 30, 1924 :—

COUNTRY OF DESTINATION.	QUANTITY. Tons.	VALUE. £
Finland	1,683	3,797
Sweden	2,465	3,813
Norway	409	1,253
Denmark	13	67
Poland	408	1,306
Germany	4,299	10,907
Netherlands	4,202	9,291
Belgium	4,578	8,160
France	1,977	4,403
Spain	400	1,071
Italy	3,970	8,962
China	1	6
Japan	1	13
United States of America	20,936	42,284
Mexico	40	158
Argentine Republic	273	1,456
Natal	—	1
Bombay *via* other Ports	1,649	6,522
Madras	33	134
Bengal	669	2,676
Hong Kong	—	2
Victoria	29	430
New South Wales	3	12
Canada	53	130
Irish Free State	8	18
Total	48,099	106,872

China Clay Imports

A RETURN showing the registered imports of China Clay (including china stone) into Great Britain and Northern Ireland from the several countries of consignment during the month of October, 1924 :—

COUNTRY WHENCE CONSIGNED.	QUANTITY. Tons.	VALUE. £
Germany	6	44
Netherlands	150	210
Total	156	254

November Deliveries

As was expected would be the case, following the heavy liquidation of accumulated stocks in October and September, at severely cut prices, as a consequence of the collapse of the Association, there was slackening in the volume of trade in November, the drop from the previous month having been 10,000 tons. Nevertheless, the total volume of trade for the eleven months shows the substantial increase of 82,712 tons over the corresponding eleven months last year, made up of 58,123 tons China Clay, 10,975 china stone, 13,614 ball clay. The details of November deliveries and comparison with immediately preceding months are :—

Monthly Figures

	China Clay. Tons.	China Stone. Tons.	Ball Clay. Tons.	Total. Tons.
Fowey	53,972	3,408	1,238	58,618
Par	5,052	458	—	5,510
Charlestown	3,672	—	—	3,672
Plymouth	4,060	46	—	4,106
By Rail	4,790	—	—	4,790
November	71,546	3,912	1,238	76,696
October totals	80,197	3,693	2,821	86,711
September totals	74,157	4,368	3,342	81,868
August totals	61,681	5,903	1,970	69,554

Eleven Months' Figures

China Clay.		China Stone.		Ball Clay.		Total Tons.	
1924.	1923.	1924.	1923.	1924.	1923.	1924.	1923.
671,843	621,737	43,602	32,857	31,275	18,202	746,720	672,796
71,546	63,529	3,912	3,682	1,238	697	76,696	67,908
743,389	685,266	47,514	36,539	32,513	18,899	823,416	740,704

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

CENTURY POTTERY CO., LTD., Burslem.—Reg. November 6, £5,369 second debenture, to J. P. Brodie, Burslem, I.A. ; general charge (subject to first debentures). *£5,476 3s. October 15, 1924.

CURRIDGE BRICK AND TILE CO., LTD., London, W.—Reg. November 24, £2,000 debentures ; general charge. *£3,000 bank mortgage. March 20th, 1924.

SALOP POTTERY CO., LTD., Broseley.—Reg. November 8, £700 second debenture, to S. Wolfson, 225, Hagley Road, Birmingham, merchant ; general charge. *Nil. January 21, 1924.

TILEHURST POTTERIES (1922), LTD.—Reg. November 20, debenture, to bank ; general charge. *Nil. September 20, 1923.

WADDINGTON (J. H.) AND CO., LTD., Beighton, paper manufacturers.—Reg. November 17, £5,900 debentures, part of £7,000 ; charged on properties at Beighton ; also general charge. *Nil. April 30, 1924.

Satisfactions

DICKINSON (JOHN) AND CO., LTD., London, E.C., paper makers.—Satisfaction reg. November 22, £2,172, part of amount reg. July 1, 1912, and January 21, 1919.

LION BRICK AND TILE CO., LTD. (late MELBODEL SYNDICATE, LTD.), London, E.C.—Satisfaction reg. November 24, £1,000, part of amount reg. June 5, 1923.

London Gazette, &c.

Company Winding Up Voluntarily

THE HEARTHCOTE POTTERY CO., LTD.—W. F. Harris, Kingston-upon-Hull, Chartered Accountant, appointed liquidator, November 21.

WHATMAN
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The range of WHATMAN Filter Papers now manufactured is the most complete produced by any mill in the world, and covers practically all the requirements of modern high-grade technical work.

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No. 1 A high grade paper for general qualitative work.
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No. 43 Similar to No. 40 but rendered Fat Free.
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Sole Manufacturers:—

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Obtainable from all Laboratory Furnishers

In sealed and labelled packages

Specialities:—

No. 12 Folded Filter Papers. **No. 14** Folded with hardened tips.
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No. 100 Fat Free Strips, for determination of fat in milk.
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No. 130 Arsenic Test Strips (unsensitized) Approximately 2.5×120.mm.

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WHATMAN ABSORPTION BLOCKS
WHATMAN DIFFUSION SHELLS
WHATMAN FILTER "HATS"

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No. 30 A single washed paper retaining medium precipitates.
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Telephone: City 7413 (3 Lines)

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No. 51 Filter Cones, made from No. 50 filter paper.

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INDEX TO ADVERTISERS

Adlam (Geo.) & Sons, Ltd.....vii, Mar. 29
Agricultural Information Bureau for the French Potash Mines.....ii, Mar. 8
Alsace Lorraine & General Products Co., Ltd.....viii, May 31
Aluminium Plant & Vessel Co., Ltd. v, Dec. 6
Alluvials Mining Machinery Co., Ltd. xxi, June 7
Amman (U.) Ltd. .....viii, Dec. 13
Anderson (William) & Co.....xx, July 5
Angel (H. Reeve) & Co., Ltd. i
Arcos, Ltd.....xii, Dec. 20
Arnold (Ed.) & Co.....iv, Nov. 8
Ashton (Thos. A.), Ltd.....xx, Aug. 30
Aspey (G.) & Son, Ltd. xvi
Audley Engineering Co., Ltd ....xxiv, Dec. 20
Australian Commonwealth Line of Steamers *Cover* ii, July 26

Babcock & Wilcox, Ltd. xxxviii
Baillière, Tindall & Cox.....xviii, April 19
Baldwin (J.) & Co. xxxix
Balfour (Henry) & Co., Ltd. xviii
Barter Trading Corptn., Ltd ....xxv, Dec. 20
Battersea Polytechnic.....xxvii, Sept. 20
Battin (H.) & Co., Ltd. xxxix
Benn Bros., Ltd. .....x, xxxviii
Benn (Ernest), Ltd. .....xxiv, xxx
Bennett & Jenner.....xxxi, Nov. 8
Bennett, Sons & Shears.....xl, Sept. 27
Berk (F. W.) & Co., Ltd.....iii
Blair, Campbell & McLean, Ltd.....*Cover* iv
Boake, Roberts (A.) & Co., Ltd. v
Booth (J.) & Son.....xv, May 3
Boots Pure Drug Co., Ltd.....v, Nov. 15
Borax Consolidated, Ltd. xiii
British Alizarine Co., Ltd. *Front Cover*, Dec. 13
British Arca Regulators, Ltd.....xxvii, Dec. 6
British Drug Houses, Ltd..... xii
British Dyestuffs Corp., Ltd .....ix, Dec. 20
British Oxygen Co., Ltd.....xiv, Dec. 20
British Steam Specialities, Ltd.....xi, Nov. 1
Broadbent (Thos.) & Sons, Ltd. xxi
Brotherton & Co., Ltd. xiii
Brotchie (G. B.) & Co., Ltd. ....xiii, July 26
Brough (E. A.) & Co.....xxxiii, July 26
Brown & Son..... xxviii
Brunner, Mond & Co., Ltd.....v, Dec. 20
Buckley Brick & Tile Co. .....xxiv, Dec. 13
Burt, Boulton & Haywood, Ltd. xix
Bush (W. J.) & Co., Ltd...*Front Cover*, Nov. 15
Buxton Lime Firms Co.....i, Dec. 20

Cain (R. G. L.) .....v, Dec. 6
Callow Rock Lime Co., Ltd. ix
Cameron (John), Ltd. .....x, Dec. 13
Carmichael (John F.) & Co., Ltd. xxxix
Carter (J Harrison), Ltd. .....xvii, Dec. 13
Carty & Son, Ltd. .....iii. Dec. 6
Castner-Kellner Alkali Co., Ltd. xiii, Dec. 20
Catterson-Smith (R. M.) .....xxvii, Dec. 6
Celite Products, Ltd.....xxi, Sept. 27
Central Importing Agency.....xlv, Mar. 29
Chadderton Conveyor Co., Ltd. xxxviii, July 26
Chambers (W. & R.).....xxx
Chance & Hunt, Ltd. xi
Chapman & Hall, Ltd.....v, Feb. 16
Chemical Catalog Co., Inc.....xiii, July 5
Chemical Engineering & Wilton's Patent Furnace Co., Ltd.....xvi, Nov. 1
Chesterfield Tube Co., Ltd....*Cover* ii, Dec. 20
Christopherson (C.) & Co.....vi
Churchill (J. & A.).....v, Oct. 4
Cohen (George) & Armstrong .....xv, Dec. 20
Cole & Wilson xxxi
Collett (J. M.) & Co., Ltd. xxxviii
Collingham & Owen xxix
Compagnie Commerciale du Nord (Great Britain), Ltd xxxix
Connell (A.) & Co. xxviii
Cook (Chas. W.) & Sons xxii
Crane (Fredk.) Chemical Co. ....xxvi, Dec 6
Crosby, Lockwood & Co.....xxvi, April 12
Crossley Bros.....xxxv, Sept. 27
Dale (John) Mfg. Co. xx
Damard Lacquer Co., Ltd.....xxviii
Davidson (F.) & Co.....xix, Oct. 4
Dawson (H. R.) & Co. xvi
Dell (Wm. R.) & Son.....xxvii
Dempster (R. & J.), Ltd.....xiv, July 12
Dexine, Ltd. .....ii, Dec. 20
Dickinson (Arthur J.), Ltd. vi
Diggory & Co.....xxviii
Dorr Co. xviii
Drug & Chemical Markets.....xx, Nov. 8
Dunn Bros. & Co. .....xxv, Dec. 20
Duroglass, Ltd. .....xxvii, Dec. 6
Electro Bleach & By-Products, Ld. xxi, Dec 20
Electro Flow Meters Co.....—
Elektrokemiska Aktiebolaget.....v
Ellison (Henry) .....vi, June 14
Enamelled Metal Products Corp.,Ld. vi,Mar. 29
Entwisle & Gass, Ltd. ..... xl, July 26
Evans, Adlard & Co., Ltd.....xvi, Dec. 20
Evershed & Vignoles, Ltd..... *Cover* iii, Dec. 20

Feltham (W. H.) & Son xxxix
Fletcher Malleable Foundries, Ltd. xvi, Oct. 18
Foamite Firefoam, Ltd. .....vi, Dec. 6
Follows & Bate, Ltd. .....xiii, Dec. 13
Forth (Chas.) & Son xxix
Foster Instrument Co .....*Cover* iv, Dec. 13
Foster (Joseph) & Sons.....*Cover* iii
Foyle (W. & G.) xxviii
Fraser (W. J.) & Co., Ld. *Front Cover*, Aug. 16

Gallenkamp (A.) & Co., Ltd. .... xxiii, Nov. 8
Gardner (Henry) & Co., Ltd. xvii
Gas & Fuel Plants, Ltd. iv
Gas Light & Coke Co. xvii
Gay, Jules de.....iv
Gee (E. T.) & Sons, Ltd. xxxii
Glenboig Union Fire Clay Co., Ltd. xxv, Dec. 13
Glew (F. Harrison) xxxviii
Gordon (Jas.) & Co. ..... x, Feb. 16
Grasselli Chemical Co., Ltd. ....xvi, Dec. 20
Greeff (R. W.) & Co., Ltd. .....xi, Dec. 20
Green (Herbert) & Co., Ltd xxxv
Greenshields (J.) & Co., Ltd.....xxvii, June 28
Griffin (J. J.) & Sons, Ltd. iii
Griffiths Bros. & Co. (London), Ltd.....vi
Grimsley & Co. (Leicester), Ltd.....ii, Nov. 1
Grose & Stocker xv
Guelph Patent Cask Co., Ltd. xx
Guthrie & Co. .....*Cover* iv, Dec. 6

Haddon (John) & Co. .....xix, July 26
Haller & Phillips, Ltd..... *Cover* ii, Aug. 2
Harding, Holland & Fry ..... xxiii, Sept. 27
Hardinge Co., Inc. .....xxv, Dec. 6
Hartley (J. H.) & Co., Ltd. .....xiv, Mar. 15
Haughton's Patent Metallic Packing Co., Ltd. xxv
Heim (S.), Ltd .....*Cover* ii, Mar, 22
Hemingway & Co., Ltd. .....liii, Mar. 29
Hensman Bros.....xviii, Dec. 20
Hickson (E.).....xxxix
Hickson & Partners, Ltd.....xii
Holliday (L. B.) & Co., Ltd...*Cover* iii, Nov. 8

FOR CLASSIFIED INDEX TO TRADES SEE PAGES xxxvi & xxxvii

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INDEX TO ADVERTISERS—*Continued*

Holmes (W. C.) & Co., Ltd. .....*Cover* iv
Hopkin & Williams, Ltd.....xxviii
Horne Engineering Co. xxvi
Houston & Laurisch .....viii, Oct. 25
Howards & Sons, Ltd. ....*Front Cover*, Oct. 18
Huber (J. M.), Ltd.....*Cover* ii
Hunt (J. T.) & Son, Ltd.....iii, Dec. 20
Huntington, Heberlein & Co., Ltd. xviii Dec. 20
Institute of Chemistry xxxii
International Electrolytic Plant Co., Ltd. ..xxiv
Jack (John) & Son.....66r, June 21
Jackson (John) & Co., Ltd. .....xxvi, Oct. 18
Jarvie (Wm.), Ltd. xxxii
Jobling (James) & Co., Ltd. xxx
Johnson (C. H.) & Sons, Ltd. .....xi, Dec. 13
Johnson (S. H.) & Co., Ltd. xxvii
Johnson & Sons, Mfg. Chemists, Ltd. vii
Johnson, Matthey & Co., Ltd.....xiv, Dec. 20
Jones (Hubert) .....xviii, Sept. 20
Kelvin, Bottomley & Baird, Ltd...xxiii, Dec. 6
Kestner Evap. & Eng. Co., Ltd. xxxiii
Lancaster & Tonge, Ltd.....xxv
Lang (A. D.), Ltd. .....x, Dec. 20
Laporte (B.), Ltd. xiv
Lazarus (Leopold) xxxviii
Le Bas (Edward) & Co. xxxvii
Leeds & Bradford Boiler Co., Ltd. xviii, Dec. 6
Leigh (R. & H.), Ltd. xx
Leitch (J. W.) & Co., Ltd. .....vi, Dec. 20
Lennox Foundry Co., Ltd.....xxxi
Leroy (F.) & Co. xxiv
Lilleshall Co., Ltd. xxvi
London & N.E. Railway .....xvi, Oct. 25
Lord (John)..... vii, Sept. 27
Macmillan & Co., Ltd. .....xxii, Feb. 23
Matthews & Mumby, Ltd. xxv
Matthews & Yates, Ltd. .....xxix, June 21
Mayer (E.), Fawsitt & Co. ....xxxviii, Sept. 27
Mayhew (Mark) .....vii, May 3
Metcalf & Co. xxxix
Midland Iron Co. .....xxix, Nov. 15
Midland Sheet Metal Works, Ltd. ..xxv, Dec. 13
Millar (James), Son & Co., Ltd. ..xvii, July 26
Millwards Merchandise, Ltd.....xiv
Mitchell (L. A.).....x.....xiv, Dec. 20
Mitchell (P. D.), Ltd. xxii
Mond Nickel Co., Ltd. .....xv, Dec. 6
Morris Cars, Ltd. .....xxvii, Aug. 30
Murray & Ramsden .....xl, Sept. 27
Musgrave & Co.....iii, Dec. 20
National Dyes, Ltd. xvi
National Glass Industry, The....viii, Nov. 29
Necol Industrial Collodions, Ltd...xiv, Dec. 13
Newcastle-on-Tyne & Gateshead Gas Co., Ltd. xvi, Sept. 27
Newton, Chambers & Co., Ltd. ....xx, Dec. 20
Nieulant, Pelkman & Co.....xviii, Nov. 22
Oertling (L.), Ltd. .....*Cover* ii
Oliver Continuous Filter Co. xxiii
Oxley (J. C.) v
Page (Chas.) & Co., Ltd. xxxiv
Pattison (J.) & Co. ..... ix, Nov. 15
Perry & Hope, Ltd. xxxviii
Plausons' Mill & Filter Press, Ltd. xiii, Aug. 23
Potash Supply Co. .....x, Sept. 27
Pott, Cassels & Williamson xxxiii
Poynter (John), Son & Macdonalds xii
Premier Filterpress Co., Ltd. .....xx, Dec. 13
Price, Stutfield & Co., Ltd.....ii
Pulsometer Eng. Co., Ltd. ....*Cover* iv, Dec. 6
Pure Bone Phosphate & Chem. Co., Ltd..xxxix
Relay Automatic Telephone Co., Ltd. xi, Sept. 20
Riddell (Wm.) & Co. .....xiii, Dec. 13
Ridge Roasting Furnace & Engineering Co. xxvii, Oct. 18
Roberts' Pat. Filling Machine Co. xxiv, Sept. 27
Robinson (J.) & Son..... liii, Mar. 29
Rowlandson (W.) & Co. xxvii
Royal Mail Steam Packet Co.....xl, Sept. 27
Rund (S.) & Co. .....xiv, Dec. 13
Russian Oil Products Co. xv
Ryding & Co..... *Cover* iii
Sawyer (E. G.) & Co. ..... vi, May 24
Scientific Glass Blowing Co. .....xiv, Oct. 4
Scott (D.) .....ix, Dec. 13
Scott (G.) & Son (London), Ltd. ..*Front Cover*
Scottish Dyes, Ltd. .....*Cover* ii, Oct. 25
Sentinel Waggon Works, Ltd. ....xvii, Dec. 20
Shepherd (James A.) & Co., Ltd...viii, Dec. 20
Sherman (J.) & Co.....vii
Shirley Aldred & Co., Ltd. .....iv, Dec. 20
Sofnol, Ltd.....xxxv
Somerset Oxide & Ochre Co., Ld. xxxviii
Spencer-Bonecourt, Ltd. ..... xi, Sept. 27
Spencer Chapman & Messel, Ltd. vii
Statham (John) & Sons xxxiv
Steam Fittings Co., Ltd. .....xvii, Dec. 20
Steel (J. M.), Ltd..... viii, Nov. 15
Stephens & Hynson, Ltd.....xvii, Nov. 29
Stockton-on-Tees Chem. Works, Ltd. xii, Dec. 20
Stott (James), Ltd. xxxviii
Sun Lane Engineering Works.....xiii, Dec. 13
Super-Centrifugal Engineers, Ltd...xx, Dec. 13
Sutcliffe Bros. & Bryce, Ltd.....xxii, Oct. 25
Sutton (Francis C.) & Co. .....xviii, Sept. 6
Synthetic Products Co., Ltd.....xxxvi
Tanks & Drums, Ltd. xx
Taylor (Jos.) (Saturators), Ltd. xxxi
Taylor System of Colour Harmony *Front Cover*, May 31
Tennant (C.) & Co., Ltd. viii
Thomas (A. H.) Co.....xxi, July 5
Thompson & Capper, Ltd. .....*Cover* iv
Thompson (Joseph) & Son.....xxv, Oct. 4
Thompson (J.) (Gas Developments), Ltd.....ii, May 10
Todd Bros. xxxii
Torrance & Sons, Ltd. .....xxii, July 19
Tuft & Templeton .....xxii, May 3
Turbine Furnace Co., Ltd. .....x, Dec 13
United Alkali Co., Ltd. ..*Front Cover*, Dec. 20
Varcoes ChinaClayCo.,Ld.*China Clay* 6, Aug. 16
Walker, Crosweller & Co. xxix
Ward (L.), Ltd. .....*Cover* iv, Jan. 19
Warrington Chem. & Drug Co., Ltd. xxiv
Washington Chemical Co., Ltd. .....*Cover* ii
Waxed Papers, Ltd. .....v, Sept. 13
Webb (William A.), Ltd.....xxxviii, July 26
Weir (A.) & Co. ..... xxix, July 19
Weir (G. & J.), Ltd. viii
Wells (A. C.) & Co. xxviii
Wengers, Ltd. xxviii
Western Chem. Co. (Paisley), Ltd. viii
Westminster Bank, Ltd. .....xliii, July 26
West's Gas Improvement Co., Ltd. xvi
White Elec. Instrument Co., Ltd. xviii, Dec. 13
White (John & James), Ltd. .....xii, Dec. 20
Whitehead (Robert).....xxvi, Aug. 30
Widnes Foundry Co., Ltd. .....xviii, Nov. 8
Wilkinson (Jas.) & Son xxxviii
Wilcox (W. H.) & Co., Ltd. .....li, Mar. 29
Wilson Bros. .....xx, June 14
Worcester Royal Porcelain Co., Ltd. xxv, Dec. 13

FOR CLASSIFIED INDEX TO TRADES SEE PAGES xxxvi & xxxvii

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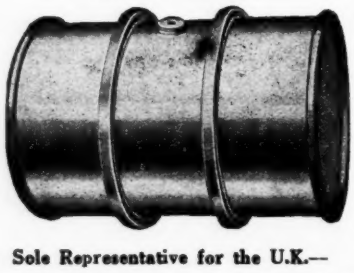

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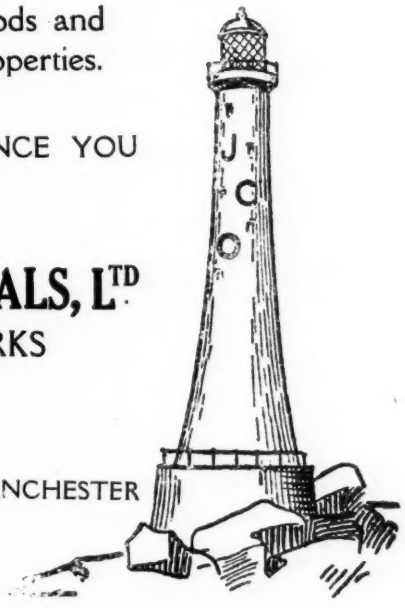

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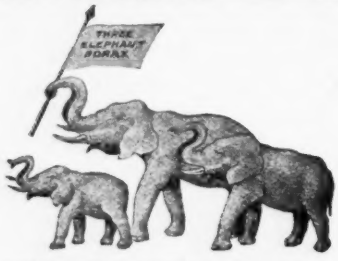

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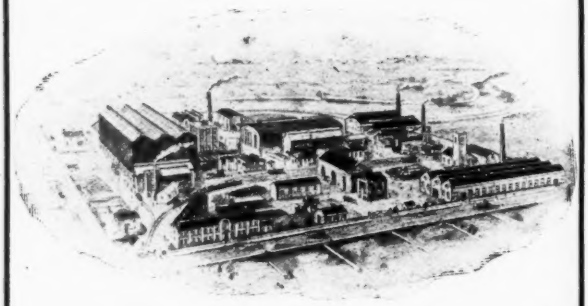

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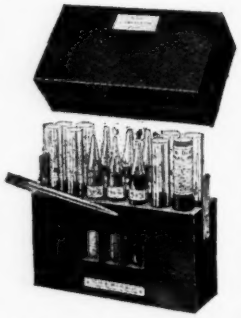

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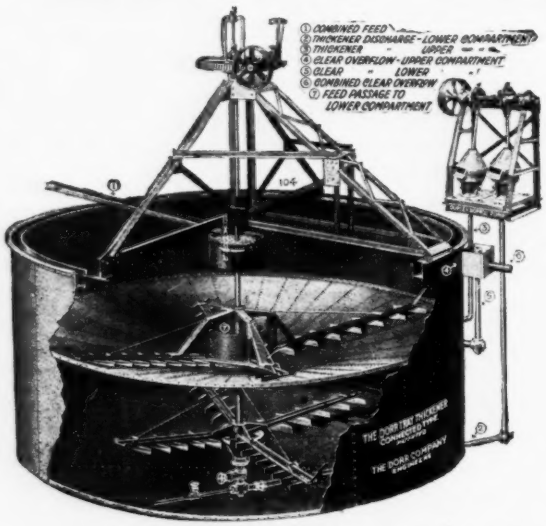
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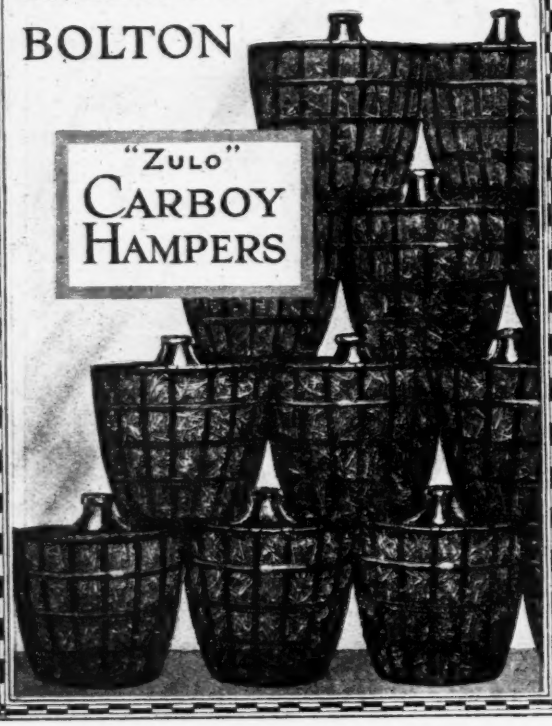

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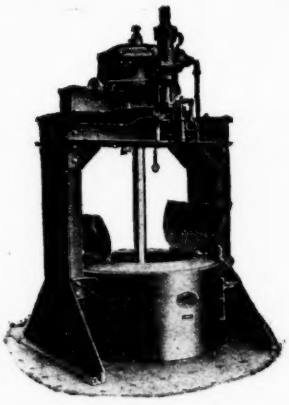

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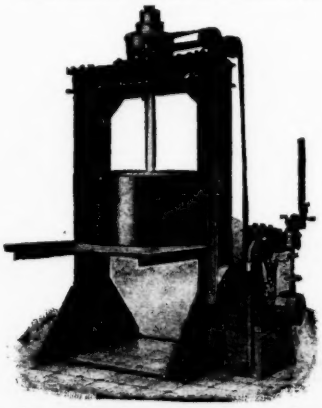

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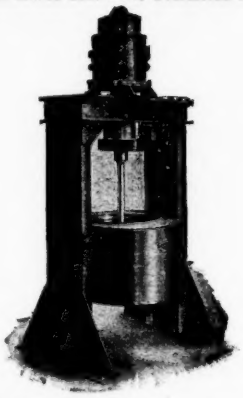

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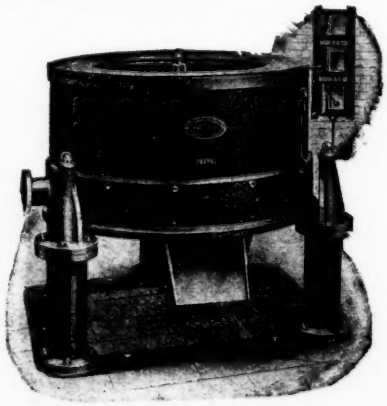

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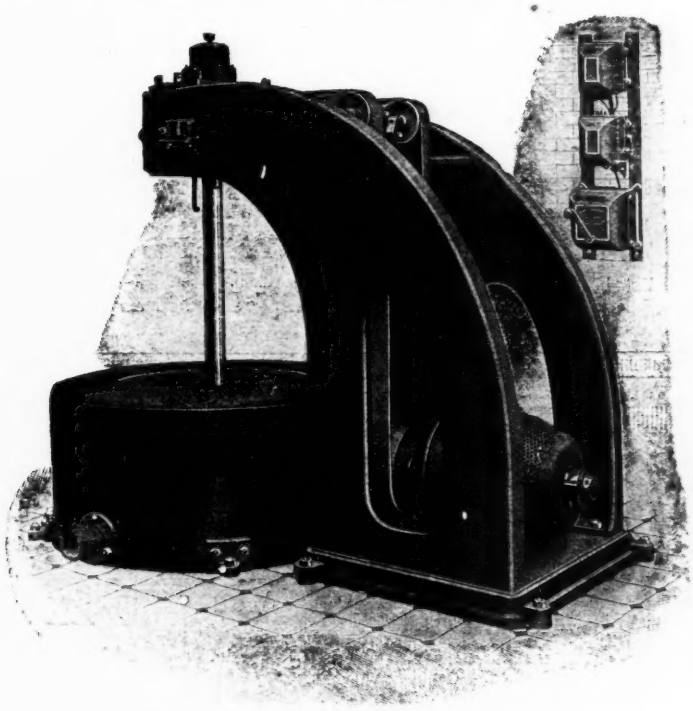

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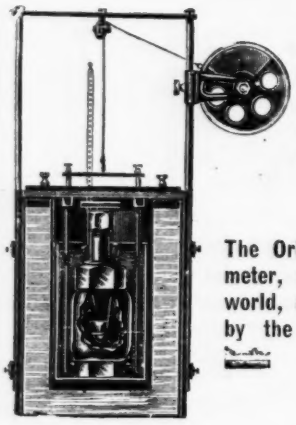

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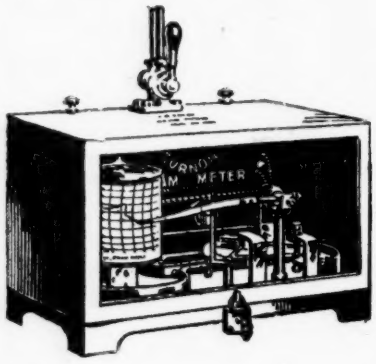

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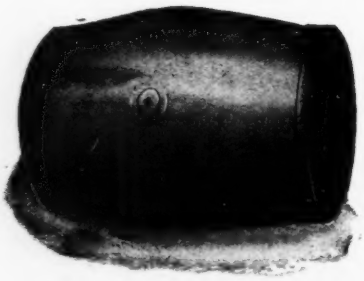

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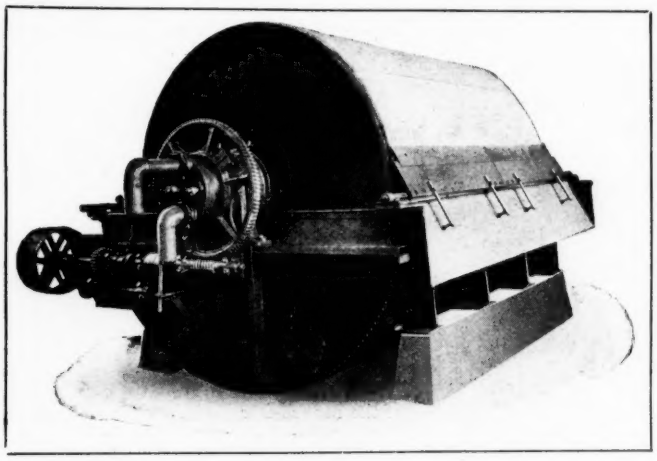

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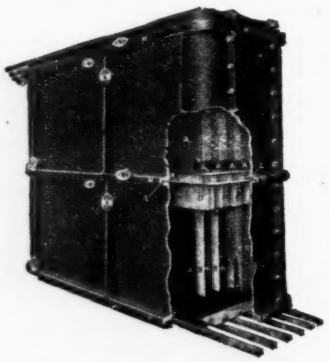

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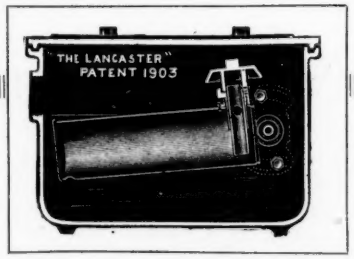

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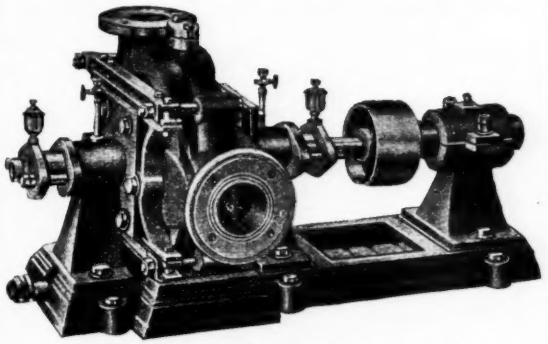

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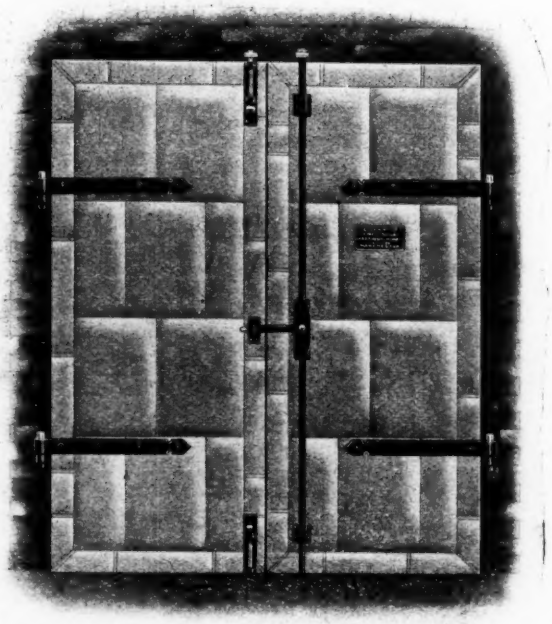

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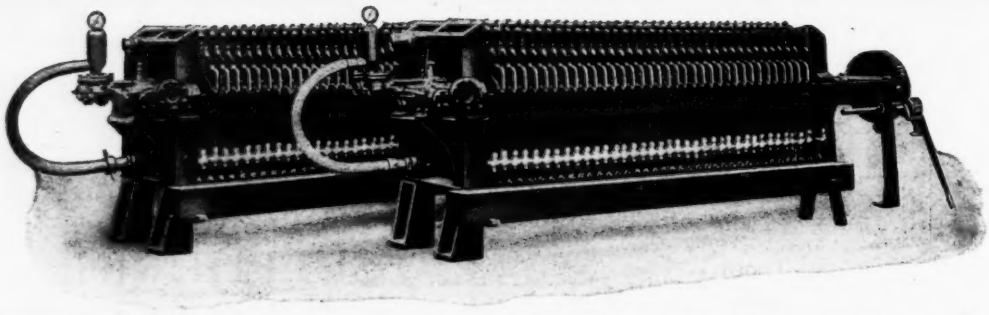

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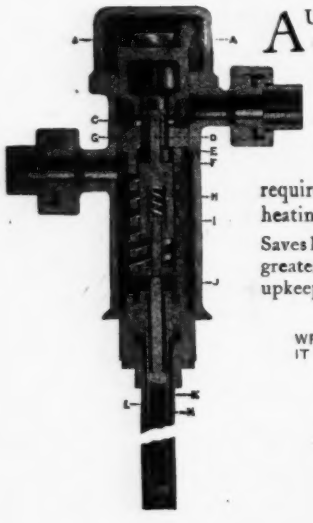

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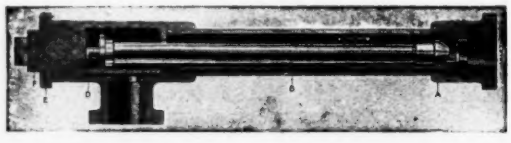

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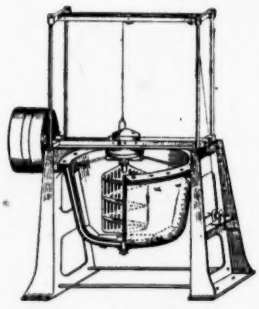

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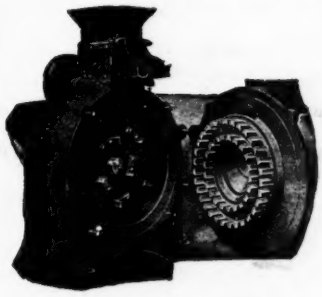

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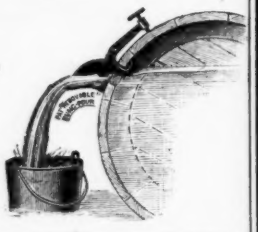

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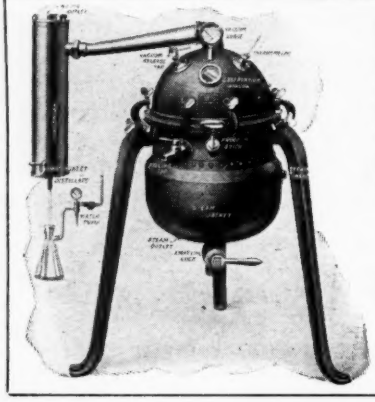

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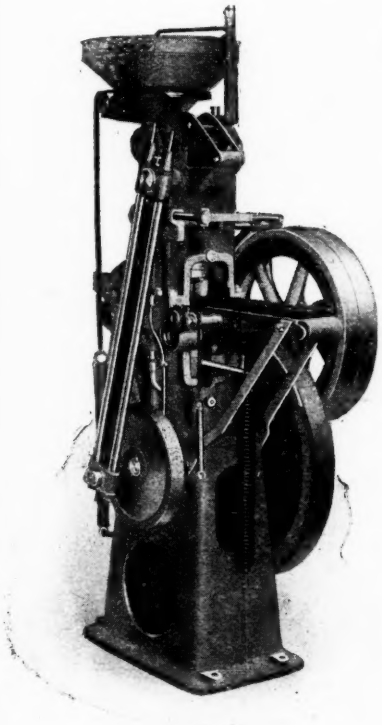

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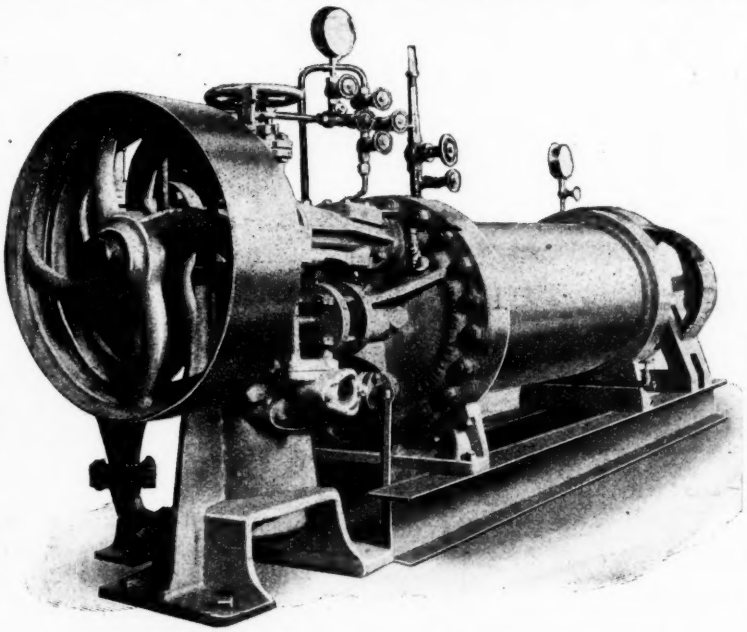

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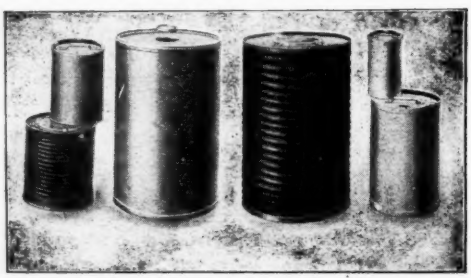

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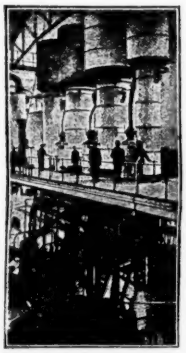

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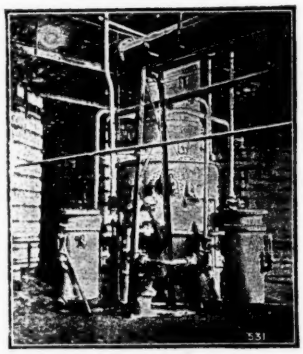

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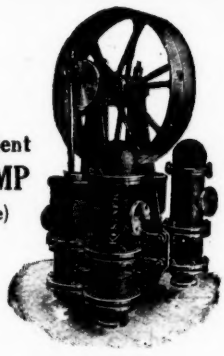

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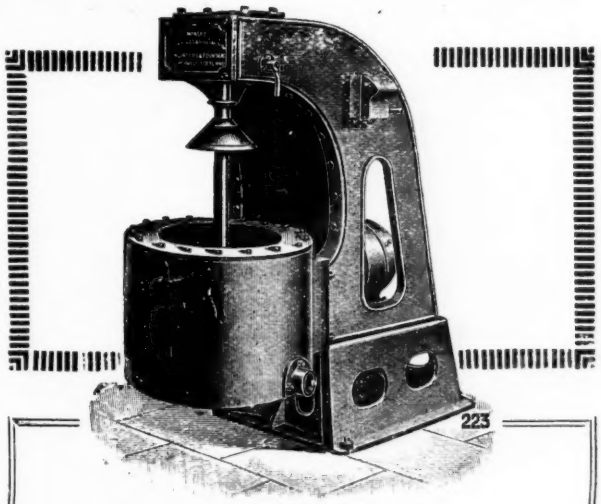

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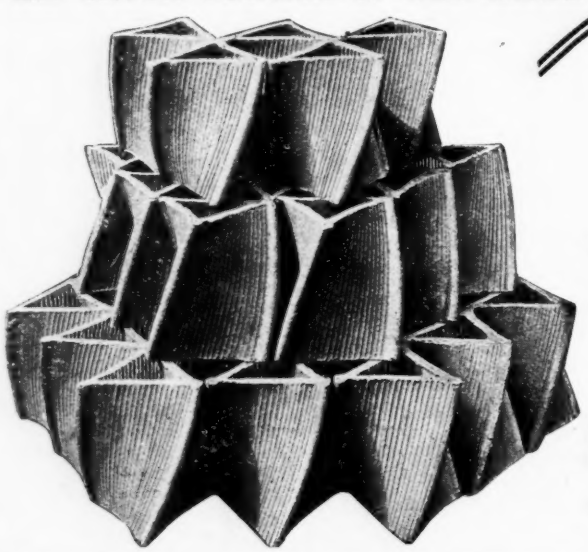

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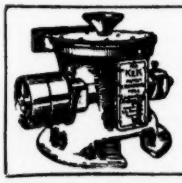

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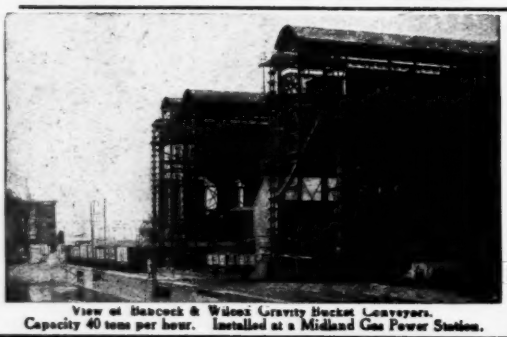
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